THE STATUS OF IOWA SLEEP-RELATED INFANT MORTALITY: AN EVALUATION OF SAFE SLEEP EDUCATION DELIVERY, POLICY, AND PRACTICE IN BIRTHING HOSPITALS

By

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Dedication

I fell in love with babies my first day in the nursery. As an undergraduate I worked in the newborn nursery at the largest hospital in Iowa. I held babies born addicted to crack, to prison inmates; babies with only a functioning brain stem allowing them to suck, cry and sleep, but only live two weeks. I gave hundreds their first baths, swaddled them for comfort and happily witnessed many weary and euphoric new mothers learning how to care for their child.

The first time I witnessed an infant autopsy, my youngest son was the same age as the victim of SIDS. I was intent on determining why an excessive number of babies were dying, possibly from some uniform infectious cause, anything but the unknown. I have read many times in literature quotes from mothers who question why their actions can prevent something that is unexplained. The truth is we know some of the reasons why babies die of SIDS and related causes. There are a multitude of factors that contribute to the "why" we just cannot fully explain why it happened "when" it did.

I believe it is possible to prevent many of these deaths with vigilance, education, and empowerment. Knowing this has propelled me through years of study, writing, meeting, motivating, speaking, and educating.

I look at my two boys who lived through their infancy and are now captivating young people. I want them to know that this work had meaning and that even if it is only one infant saved, that is one less infant absent from the world.

I could not have succeeded in this endeavor without my partner, a physician, who has helped me comprehend the world of clinical practice. He edited my pages, pushed me through countless hours of writing, and sometimes made me take a much-needed break. I cannot imagine doing this without his incessant love and support.

I dedicate this writing to the parents who are just now falling in love with their new little one. I hope my work ensures that you *always* secure a safe sleep space for your baby.

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ABSTRACT

Problem: Sleep-related infant mortality, including sudden infant death syndrome, asphyxia, and undetermined or unknown causes, is the third leading cause of death nationally and in Iowa (Harris, 2014; Malloy & Ramirez, 2013). Evidence exists for increasing rates of bed sharing, a major risk factor for sleep-related mortality (Kemp et al., 2000). Preventive messaging is most widely and effectively delivered by health professionals at time of birth (Shaefer, Herman, Frank, Adkins, & Tehaar, 2010). The intent of this study was to provide a characterization of infant, maternal, and environmental factors contributing to sleep-related infant mortality and a comprehensive review of safe sleep education policy and practices in Iowa birthing hospitals.
Procedures: An experimental, cross-sectional study design was used to analyze infant mortality data reported by the Iowa Office of the State Medical Examiner to the Child Death Reporting system from 2004-2012. Analyses included mortality trends for sleep-related mortality parsed by Sudden Infant Death (SIDS), asphyxia, and undetermined or unknown cause, descriptive statistics for maternal and infant demographic factors, and correlations for environmental factors potentially contributing to sleep-related death. An adjacent effort with Iowa birthing hospitals involved use of a web-based survey to assess policies, parent education programs, clinical practice, and training related to safe infant sleep or SIDS. The survey was directed toward obstetric unit coordinators with content drawn from previous efforts to ascertain clinical practice.
Findings: Sleep-related mortality in Iowa has been steadily increasing since 2004. Sub-categorical examination of this trend revealed rises in SIDS and undetermined or unknown cases, but a stable rate of deaths due to asphyxia. These infants (n=384) were more often males (58.6%), lived an average age of 102 days, were living with multiple children at time of death, and had a young mother. An alarming 42% of infants were bed sharing at time of death, with only 43% placed on their back to sleep prior to the event. Significant racial disparities were present. Non-white infants were more likely to have died while bed sharing compared to white infants, Pearson $\chi 2(1, n=151)=6.7$, $p=0.01$, and non-white infants were also more likely to usually sleep someplace other than a crib, Pearson $\chi 2(2, n=151)=5.05$, $p=0.025$.
The hospital survey (N=42) revealed that three-quarters have policies addressing SIDS or safe sleep education. Of those with policies, topics covered included sleep positioning, surface, bed sharing, and the infant's sleep environment. Respondents indicated nearly uniform demonstration of supine sleep, though some cited fear of aspiration, as a reason supine sleep might not be used. Less than half of hospitals require clinical staff to complete safe sleep education training. Unit coordinators rated their SIDS or safe infant sleep programs an average strength of 7.66 out of 10.
Conclusions: Sleep-related mortality incidence in Iowa is increasing and state-specific risk factors exist. Racial disparities in sleep environment practice are of particular concern. Hospital policy addressing safe infant sleep is not universal. Consistent demonstration of supine sleep may be inhibited by concerns over aspiration. Training opportunities could be improved as access to programs external to the hospital setting and online are not fully utilized.
Recommendations: Greater awareness of the risk factors associated with sleep-related infant mortality is needed among parents and caregivers of infants. Expansion or strengthening of existing hospital-based education programs may improve protective parental actions. The Health Belief Model may be an important tool in examining why parents are not be universally adhering to guidance against bed sharing.

CHAPTER I

INTRODUCTION

From the time of its formal recognition in 1969 through present day, Sudden Infant Death Syndrome (SIDS) has claimed the lives of thousands of infants (Malloy & Ramirez, 2013). These events are exceptionally challenging for parents and caregivers, as the diagnosis of SIDS provides no rationale as to why an infant dies. It is an explanation of last resort used only when all other known or suspected causes have been exhausted. Despite there being no singular known cause for SIDS, much progress has been made in identifying risks and protective factors. However, years of stable rates of SIDS in addition to increases in like events involving asphyxia or suffocation emphasize the importance of continuing to study SIDS.

Approximately 55,000 children under age 19 years die every year in the U.S.; half due to preventable causes (Michigan Public Health Institute, 2011). As early as 2010, Sudden Infant Death Syndrome (SIDS) remained the third leading cause of death for infants less than one year of age in the U.S. and was the primary cause of deaths during infancy beyond the neonatal period, defined as 0-27 days after birth (Barfield et al., 2013; Bettegowda, Lackritz, & Petrini, 2010; M. Harris, 2014; T. J. Matthews & MacDorman, 2013). In Iowa, an average of 43 deaths due to SIDS, asphyxia, and unknown causes occur annually (M. Harris, 2014). Causes of postneonatal mortality, occurring 29 to 364 days after birth, in Iowa, lead with congenital anomaly, followed by complications of the perinatal period, and then SIDS (Iowa Department of Public Health, Bureau of Vital Statistics, 2013). Iowa incidence aligns with national trends where congenital malformations, perinatal complications and SIDS account for 46% of infant deaths (T. J. Matthews & MacDorman, 2013).

Since 1950, advances in clinical practice and medical technology have helped reduce all-cause infant mortality (Barfield et al., 2013). In recent years from 2000-2007, national all-cause infant mortality rates stagnated, then began a decline approximately three percent each year from 2007-2011 (Barfield et al., 2013; T. J. Matthews & MacDorman, 2013). Similar, though delayed patterns in the reduction of infant death were also apparent in Iowa with a reduction in neonatal mortality, specifically prematurity, starting in 2007 (M. Harris, 2014). The most significant action to impact sudden unexplained infant deaths (SUIDS), specifically SIDS, were the "Back to Sleep" education campaign. These campaigns, targeted at parents of infants, emphasized placing infants on their back when laying the infant down to sleep for at least the first few months of life (Gilbert, 1994; Malloy & Ramirez, 2013). This international effort had strong support in scientific literature and after promotion in the early 1990's SIDS rates fell dramatically (Douglas, Gupta, Helms, Jolliffe, 1997). As a result of "Back to Sleep", the SIDS rate decreased by almost 50%, from 1.2 per 1,000 live births to 0.67 per 1,000 live births from 1992-1999 in the United States (Malloy & Ramirez, 2013).

Sudden unexplained infant deaths are inclusive of three categories: accidental suffocation and strangulation in bed (ASSB), ill-defined deaths, and SIDS (Barfield et al., 2013). SIDS still accounts for 25% of deaths in infants who are ages 1 month to 1 year, and while rates of SIDS declined from 1995-2005, the occurrence of ASSB increased (Goutas et al., 2011). Early SIDS research has historically centered on the identification of uniform cause such as undiagnosed genetic mutations, illness, or incapacitating syndromes. The triple-threat hypothesis introduced in 1994 allowed for the inclusion of ecologic factors. The three components of the hypothesis are a susceptible infant, in a critical developmental period, and an exogenous stressor, such as sleep position (Filiano & Kinney, 1994; Guntheroth & Spiers, 2002). More recent studies are

focused on the provision and acceptance of safe infant sleep practice and other factors known to lessen the risk of SIDS death.

Given the decrease in SIDS and increase in ASSB, sleep environments have become an essential focus for prevention. Safe infant sleep environments are defined as an infant placed on his or her back, in a crib with fitted sheets lacking soft objects and loose bedding placed in the same room as a parent. "Wedges or positioners" and cardiopulmonary monitors should not be used (Meadows-Oliver & Hendrie, 2013; Moon, 2011). Pacifier use is encouraged, as is breastfeeding (Malloy & Ramirez, 2013).

A long-standing authority on safe infant sleep practices is the American Academy of Pediatrics (AAP). The organization is highly regarded internationally and in the US. The AAP regularly releases recommendations on safe infant sleep practices. Recent guidelines from 2011 emphasize a new, but not unfamiliar practice of parents room-sharing with their infant, without bed sharing otherwise referred to as "room-sharing" or "co-sleeping" (Moon, 2011). Breastfeed is an important protective factor for SIDS (Hauck, Thompson, Tanabe, Moon, & Vennemann, 2011). Evidence has shown that breastfeeding mothers feed more often and longer while co-sleeping overnight; however, the risk of SIDS or death due to asphyxia outweighs the benefits of breastfeeding while bed sharing (mother and baby sharing a sleep surface) (McKenna & Mosko, 1997). To encourage close proximity of mothers and infants, co-sleeping or room sharing, where mother and baby sleep in the same room, but in separate beds, is now recommended (Moon, 2011). The original back to sleep recommendations released by AAP in 1994, allowed for back or side sleep, using side sleep only when the infant's lower arm was extended to prevent roll over. These recommendations were endorsed by the US Public Health Service and the SIDS Alliance (Hein & Pettit, 2001). Revised AAP guidelines in 2007 continued to allow for infant

positioning on the infant's side or back despite numerous studies citing significantly higher risk of SIDS in any position other than supine. Finally, in 2011 the guidelines changed again and supine sleep was then the only recommended sleep position (Task Force on Sudden Infant Death Syndrome, 2011).

Copious evidence exists supporting supine positioning and separate sleep environments for infants, yet these practices are not universally followed by parents (Ateah & Hamelin, 2008; Colson et al., 2013; Colson, Bergman, Shapiro, & Leventhal, 2001; Von Kohorn, 2010). Recent studies suggest that rates of bed sharing are actually increasing, and at a significant rate for blacks and Hispanics who are already disproportionately affected by SIDS (Colson et al., 2013).

Parents of infants receive information from three primary sources, 1) family and friends, 2) the media, and 3) health professionals (Von Kohorn, 2010). Health professionals interacting with parents include hospital staff around the time of delivery, primary care providers seen after hospital discharge, and possibly home health or child health clinic professionals. Many studies have emphasized the substantial influence health care providers have on safe infant sleep practices (Esposito, Hegyi, & Ostfeld, 2007; Gelfer, Cameron, Masters, & Kennedy, 2013; Hein & Pettit, 2001; Moon, Kington, Oden, Iglesias, & Hauck, 2007). Nurses and physicians providing education after delivery are most effective if supine sleep is the only recommended position, items in cribs are not allowed, and co-sleeping is overtly discouraged. Education is reinforced if the professionals providing education combine all recommendations with demonstration and action.

It is apparent that health professionals are the key to further reducing SIDS. Less than one percent of infants are born outside of a hospital thereby ensuring interaction between health professionals and most parents of newborns (MacDorman, Mathews, Declercq, & others, 2012).

Recommendations for safe sleep may be further iterated when parents visit with primary care providers, home health, or other providers. However, there are obstacles to accepting and demonstrating safe infant sleep practices among health professionals, particularly nurses. Studies prior to and following AAP recommendations for back to sleep show lack of uniformity in demonstrating and verbalizing the recommendations. In several studies, back or side sleep were used the majority of the time by nursing staff, with supine exclusive rates between 50-63% (Bullock, Mickey, Green, & Heine, 2004; Hein & Pettit, 2001; Price, Gardner, Hillman, Schenk, & Warren, 2008; Shaefer et al., 2010; Stastny, Ichinose, Thayer, Olson, & Keens, 2004). Even when supine sleep was practiced exclusively, many infants were resting in an unsafe environment with one or more items in the crib (Mason, Ahlers-Schmidt, & Schunn, 2013).

Self-reported nurse's adversity to uniform use of back sleep is concern about the risk of asphyxia or aspiration (Bullock et al., 2004; Price et al., 2008; Stastny et al., 2004). Supine positioning is an unfounded contributor to aspiration (Byard & Beal, 2000; Malloy, 2002). Other fears preventing complete observance of supine sleep included adherence to guidelines allowing side sleep, better sleep, and personal habit (Hein & Pettit, 2001). Information on parental rationale for not using supine sleep is limited, but appears to be the same as nurses. Importantly, direct correlations between nursing and physician behavior and parental sleep positioning are strong, and supersede even the advice of friends and family (Colson et al., 2001; Colson & Joslin, 2002; Von Kohorn, 2010).

It has been almost 20 years since safe sleep education in Iowa birthing hospitals was assessed. At that time, almost 90% of nursing staff in Iowa birthing hospitals were using either back or side sleep (Hein & Pettit, 2001). Successive years of unchanged SIDS rates paired with nationally reported increases in ASSB mortality supports the need for a comprehensive survey of

safe sleep education. A statewide examination of safe sleep environment instruction is the best method of determining whether standardized, uniform, and enforced educational protocols are necessary to further reduce SIDS incidence.

Given the across-jurisdiction variability in application of SIDS definitions in the United States and the mounting evidence that sleep environment hazards probably contribute not only to SIDS but to all SUIDs, there is a critical need to develop effective interventions for ensuring a safe sleep environment for all infants (R. Matthews, 2013). Interventions for SIDS are established, but present-day efficacy, use, and distribution are not known.

Statement of the research problem

SIDS remains the third leading cause of death both nationally and in Iowa. Mortality rates are unchanged since 2000, and have gradually risen among black and Hispanic populations (Colson et al., 2013). In Iowa, SIDS and related-cause infant mortality have averaged 43 cases per year since 2007 (M. Harris, 2014). Examination into why mortality rates appear unchanged and is increasing in some populations is needed. In addition, review of the prevalence of risk factors may provide an in-depth understanding of trend patterns.

Many SIDS and sleep-related mortality cases have a known or suspected cause and several recommendations and protective factors are known. Safe sleep environments provide critical assurance for infant survival, yet an increasing number of parents are not observing AAP recommendations against bed sharing (Colson et al., 2013; Kemp et al., 2000). In fact, recent research supports an increase in the prevalence of bed sharing, particularly among black infants (Broussard, Sappenfield, & Goodman, 2012; Hauck et al., 2002; M. Smith, Liu, Helms, & Wilkerson, 2012). While the increase could be tied to the extensive promotion of breastfeeding, limited evidence supports improved breastfeeding with bed sharing (McKenna & Mosko, 1997).

The risk of sleep-related mortality outweighs the benefits of breastfeeding while bed sharing (Hauck et al., 2011; Malloy, 2002). As a safer alternative, experts emphasize the advantage of co-sleeping for nursing mothers (Moon, 2011; Scragg & Mitchell, 1996).

Another alarming trend is the percentage of parents using non-supine sleep. Studies demonstrate that only 34-36% of parents place infants exclusively on their backs, while many still use side sleep and a significant number even use prone positioning which is the position with the greatest risk for SIDS (Brenner et al., 1998; Moon & Omron, 2002; Schnitzer, Covington, & Dykstra, 2012b).

Less than one percent of births occur at home (MacDorman et al., 2012). Therefore, most births happen in a hospital environment, where the majority of parents receive newborn care instruction (MacDorman et al., 2012). Instruction is usually provided by nursing staff, regardless of whether the infant has a typical two or three-day inpatient stay or spends extended time in neonatal intensive care. Studies demonstrate the actions of nursing staff, such as consistently placing infants on their back in a crib free of soft objects and loose bedding, has an impact on whether parents follow safe sleep instruction at home (Bullock et al., 2004; Hein & Pettit, 2001; Mason et al., 2013; Price et al., 2008). Physicians encountering parents during their hospital stay and at routine well baby exams also have a strong impact on parent practice, but must iterate a uniform message multiple times (Moon et al., 2007).

Practices adverse to safe sleep environments such as co-sleeping and non-supine sleep are widely recognized as a major risk factor for SIDS, asphyxia, and unknown or undetermined death in infants, yet these practices continue to occur and are increasing. Examinations into safe sleep practice and education occurring in the hospital setting uncovered a lack of universal acceptance of exclusive supine sleep by nursing staff (Colson & Joslin, 2002; Shaefer et al.,

2010; Von Kohorn, 2010). As previously stated, studies support the most efficacious and widely received opportunity to disseminate safe infant sleep education is at birth, therefore a current examination into hospital nursing practice, acceptance and modeling of the 2011 AAP guidelines, and hospital policy support for these guidelines is needed. Deficiencies identified in the provision of safe infant sleep education may provide opportunities for improvement for all birthing hospitals and may ultimately result in fewer infant deaths.

Iowa's network of obstetric coordinators may benefit from the findings of this study, including the ability to compare practices across similar facilities, learn of programs or strategies to reduce infant death, and detailed characterization of infant mortality cases for use in providing targeted education. Drawing information beyond the hospital setting further promotes protection of infants and potentially involves community partners critical for spreading the message of safe infant sleep following hospital discharge. "Teaching new mothers about safe sleep needs to extend outside the hospital. Prenatal and postnatal clinics are important partners for teaching and reinforcing infant safe sleep practices as are child care centers, churches, and community (Shaefer et al., 2010)." A comprehensive, community-based approach to promoting safe infant sleep practices will augment efforts to prevent SIDS and related infant deaths.

Purpose statement

The purpose of this study is to provide a characterization of infant, maternal, and environmental factors contributing to SIDS and related cause mortality and comprehensive review of safe infant sleep practices in Iowa birthing hospitals. Analyses will provide insight into the prevalence of factors known as contributory to the incidence of deaths attributed to SIDS, asphyxia, undetermined and unknown causes, and factors potentially unique to Iowa.

Research questions

Safe infant sleep education is not standardized in the 70 birthing hospitals in Iowa. The components of a comprehensive safe sleep program include hospital staff training and continuing education, the presence of an onsite obstetric coordinator, provision of safe sleep education to parents of newborn infants, and hospital policy detailing the protocol for safe sleep education and demonstration (Mason et al., 2013; Price et al., 2008; Shaefer et al., 2010). An assessment of hospital-based safe sleep education is needed to establish a baseline of hospital nursing practices. Three main research questions will be addressed by this study, 1) Are there disparities among infants who die of sleep-related causes, what are the demographic and circumstantial characteristics of those fatalities, and what infant, maternal and environmental factors predict sleep-related mortality incidence, 2) what are the types of safe infant sleep initiatives supported and administered by Iowa birthing hospitals, and 3) what variances or deficiencies exist among birthing hospital education and clinical training programs that might be addressed to reduce the incidence of sleep-related infant mortality.

Significance of the study

In 1996, researchers examined safe infant sleep practice among nurses in Iowa. This was after "Back to Sleep" programs were initiated, yet before the explicit guidance from AAP for supine sleep, without co-sleeping, with the infant located in his or her parents' room. It is unknown whether adjustments to AAP SIDS prevention direction have been heeded in birthing hospitals and a review of current practice is needed. In addition, the child death review team has recently worked to better characterize infant death. A stronger description of the demographics of affected infants and their caregivers, the epidemiology of SIDS, as well as extrinsic factors contributing to death would be of value. Such evidence aids in focusing recommendations from

the child death review team, programs aimed at reducing SIDS, and healthcare efforts to impact incidence.

Conceptual framework

Bronfenbrenner's ecological model

Infants are at the center of this research, ensuring survival beyond the most vulnerable stages in childhood where the infant has complete dependency on others. This study examined two levels of critical interaction that have the opportunity to be of influence: 1) The interaction between the hospital system within which the infant was born, and 2) the interaction between the infant and his or her parent or guardian. Bronfenbrenner's ecological model is an excellent theoretical framework for use in this study. It also provides a structure appropriate for categorization of previous studies and placement of necessary future work.

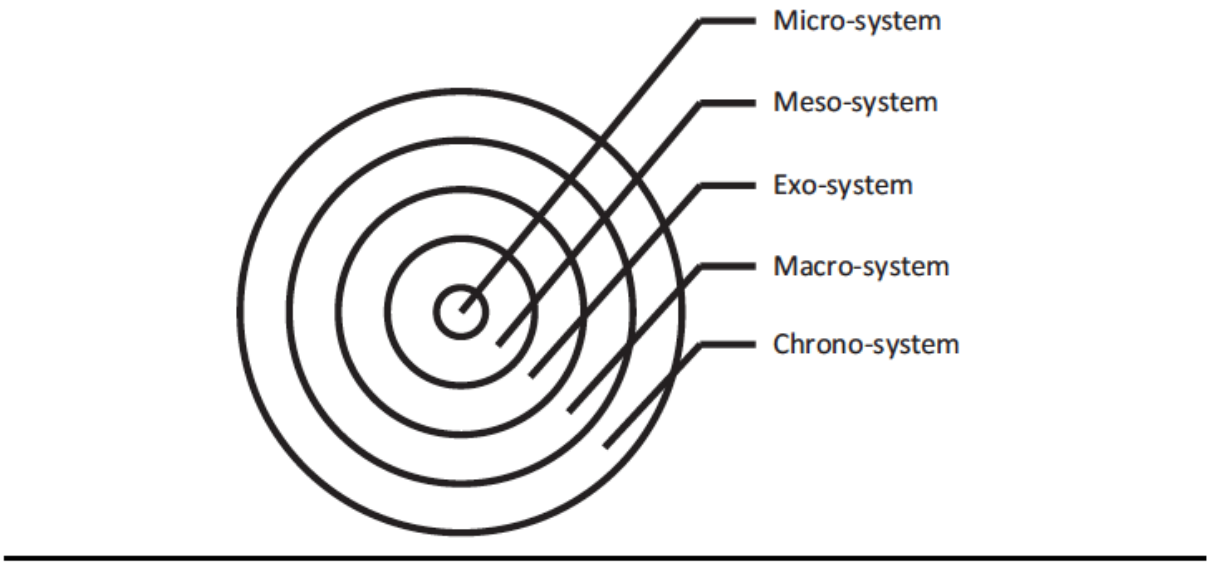


Figure 1.1 Bronfenbrenner's Bioecological Model

"Development refers to change in individuals toward progressively more complex and adequate functioning in their environments" (Arnold, Lu, & Armstrong, 2012). Experiences or interactions facilitate growth as the complexity of these interactions increases.

Bronfenbrenner's model details a series of five systems around the child; "a multi-layered set of nested and interconnected environmental systems" (Figure1). The micro-, meso-, exo-, macro-, and chrono-systems have distinct interaction and influence on the child center without mutual exclusivity. The "environment" is defined as "any event or condition outside the person that either influences or is influenced by the developing person" (Sontag, 1996). It is also important to define "interaction", which refers to exchanges between the person and other people, objects or symbols in his or her surrounding. The magnitude of the effect of each system seemingly decreases with proximity, but the potential for substantial change may originate from anywhere (Mc Guckin & Minton, 2014).

Micro-system. The micro-system is the closest level to the individual in terms of proximity and socialization. This system consists of interpersonal interactions with the infant including face-to-face visualization of a person with familiar physical features (Sontag, 1996). These interactions are concrete and involve "the immediate social and physical environment" (Arnold et al., 2012; Bryans, Cornish, & McIntosh, 2009). They have a direct impact on the child. Bronfenbrenner believed that interpersonal relationships did not exist in a vacuum, but were "embedded in the larger social structures of community" (Ceci, 2006). Examples of this include parents, caregivers, and immediate family. Most relationships are dyadic and closely interpersonal. McGuckin and Minton (2014) note that expansiveness of this system may enhance a child's development.

Meso-system. This system is characterized by interactions between at least two micro-systems, or those with frequent but less intensive relationships with the child compared to the micro-system. Akin to micro-systems, strength and variety in the types and number of these types of relationships may be influential on an infant's development. Additionally, "meso-

system relations may consist of intersetting knowledge…information or experience that participants in one setting have about the other" (Sontag, 1996). "Mesosystem interactions are connections across microsystems" where the child's network is comprised of interlinked relationships, things, and symbols (Arnold et al., 2012). Child development may be enhanced if settings within the meso-system are strongly linked (Bryans et al., 2009). Within the context of the present study, these relationships may include the nurse caregivers at delivery and while in the hospital, daycare providers, neighbors, or close friends of the family. According to Esposito, Hegyi, and Ostfeld (2007), "Nurses have a unique opportunity to achieve an effective parent-provider relationship with new parents and caregivers and thus educate and influence the family". Previous studies have cited the proximal effect of cultural and family beliefs or direction on safe infant sleep practice (Colson et al., 2001; Moon & Omron, 2002; Von Kohorn, 2010). Akin to micro-systems, "the most influential mesosystems are those that invite increasing complexity across" many facets (Arnold et al., 2012).

Exo-system. The exo-system is more far-reaching in terms of scope and may indirectly influence an infant's development. It encompasses connections occurring between two or more systems or settings, none of which are likely to contain the person, but that influence the micro-system hosting the developing child (Arnold et al., 2012; Sontag, 1996). The ecology of this system extends to governmental systems, "local health and social organizations and workplace" (Bryans et al., 2009; Mc Guckin & Minton, 2014). Exosystems encompass social structures "such as community characteristics…the organization of social services" (Arnold et al., 2012). The exo-system is the primary setting for this study as hospital policy and practice affect parental sleep care of their infants. Hospital policy and health care provider practice, belief, and demonstration affect the micro-system of parents and children by way of parental action taken in

creating a sleep environment for their infant. However, this study examines the practice of administering safe sleep education, which is classified in the mesosystem of this model.

Macro-system. The macro-system embraces "cultural, political, and ideological factors that shape and influence the microsystems" (Bryans et al., 2009). The macrosystem contains "language, metaphors, and large concepts that construct experience" (Arnold et al., 2012). Studies of racial disparity in sleep-related infant mortality have focused on the macro-system of Bronfenbrenner's model despite a simultaneous presence in micro- and meso-systems. Apparent racial disparity may stem from cultural experiences and exposure specific to a race group. Characteristics of African American communities, where rates of sleep-related infant mortality are disparagingly higher than in predominantly Caucasian communities, include cultural beliefs such as "lack of plausibility", belief in vigilance to prevent SIDS, and random incidence of SIDS (Moon, Oden, Joyner, & Ajao, 2010). Such beliefs are presented and reinforced within the macro-system representing cultural and ideological practices. It is imperative to include an examination of racial and ethnic disparity in this study as interventions must be targeted to those disproportionately affected. Of importance is the ability for something as broad as a macro-system to change through societal shifts attributed to "economic recession, war, or technological change" (Mc Guckin & Minton, 2014). The macro-system represents a "pattern of micro-, meso-, and exosystems characteristic of a given culture, subculture, or other broader social context" including language, concepts and inferences (Arnold et al., 2012; Ceci, 2006).

Chrono-system. The chrono-system "accommodates the ongoing reciprocal periods of development between the individual and the environment across the lifespan" (Mc Guckin & Minton, 2014). The potential for these temporal influences is great in the infantile period, as the

birth of a child may influence socioeconomic status, family structure, and residence. The presence of this system in Bronfenbrenner's model has striking significance for SIDS mortality research because a component of the widely accepted explanation termed the triple-threat hypothesis involves a developmental period in homeostatic control (Guntheroth & Spiers, 2002). This phase of vulnerability is temporal and has been narrowed to the infantile age range of two-four months.

Use of Bronfenbrenner's Ecological Model. The systems of engagement and levels of interaction all play a critical role in infant survival. The explanation of a sleep-related fatality is elusive and involves a sequential, process-oriented inquiry assessing all pressures on an infant's final sleep place and position. All previous SIDS research focuses on one or multiple levels within the ecological model. The present study will employ a multi-level approach. The mesosystem is a critical platform for reviewing interactions between nursing staff and parents and infants. Mode and content of instruction affect parental behavior, and infant care provided by nurses has a separate and significant effect.

On the macro-system level, hospital-based education provided to parents of newborns is influenced by policy, standards, and community practice. Nursing staff training and physician actions fall under this system review. The inclusion of a macrosystem assessment allows review of cultural constructs potentially affected by nursing attitudes or actions. Analysis of factors such as race, socioeconomic status, maternal education, and geographic location of residence are appropriate for the macrosystem and establish a foundation inclusive of these potential contributors to SIDS.

At the pinnacle of motivation for reducing SIDS infant mortality is the requisite for "promoting cross-agency coordination of assessment and integrated children's services", which

is best conceptualized using this ecological theory (Bryans et al., 2009). A multi-layered approach provides optimum framework of not only the systems impacting infant development and environment, but also how these levels might interact to magnify an effect resulting in extremes of SIDS incidence.

Model assumptions. The current study assumes the presence of a parent/child interaction post discharge. Also assumed are routine situations where health care staff encounters parents of newborns in a hospital setting.

The Health Belief Model

A second model was employed to provide framework for the examination of hospital policy and practice. The health belief model is most often used to evaluate health programs to identify which components of a program are most likely to result in action (Boslaugh, 2014). However, the model was used in this study to section aspects of safe infant sleep beliefs to be later used for evaluation. The results of this study aided to construct components of the health belief model likely to encourage parents to follow through with recommended preventive actions. Presentation of an intervention program in this format may be useful to hospital administrators and OB coordinators seeking assurance or guidance with employing an efficacious safe sleep education program.

The health belief model was developed in the 1950's as a means to evaluate the failure of a health program on tuberculosis screening (Abraham, Norman, & Conner, 2013). The model "proposes that people will be motivated to carry out preventive health behaviours such as wearing a cycle helmet in response to a perceived threat to their health" (Abraham et al., 2013). Assumptions of the model are that individuals will take health action if:

- The individual feels a negative health condition may be avoided,

- There is a positive belief that by taking a certain action, the detrimental health condition will be avoided, and
- The action is reasonable to perform.

Psychologists derived four constructs representing perceived risks and benefits. The constructs are perceived susceptibility, perceived severity, perceived benefits, and perceived barriers (Abraham et al., 2013; Boslaugh, 2014; Montanaro & Bryan, 2014). Health interventions designed with these constructs addressed may be evaluated to assess the intervention outcome or call to action.

Perceived susceptibility. In terms of administering safe sleep practice and education in birthing hospitals, there are challenges to employing the perceived susceptibility component of this model. First, SIDS is perceived as an event with unknown cause so prevention is difficult for some to comprehend. One significant qualitative study documented this obstacle and the importance of addressing the ability to reduce SIDS risk especially among populations disproportionately affected by the event (Moon et al., 2010). However, solid statistical evidence exists that if certain risk factors are avoided then SIDS risk is reduced. These factors include all potential exogenous stressors in an infant's sleep environment such as sleep place, sleep surface sharing, position, room temperature, and smoke exposure. Another approach may be to include SIDS as part of sleep-related deaths. Parents can understand the danger of accidental suffocation and asphyxia, which has nearly identical prevention measures as SIDS.

Perceived severity. Addressing perceived severity is easily the strongest motivator when expressing the need to act in reducing SIDS and related cause risk. Death of an infant is undoubtedly a devastating thought for parents and caregivers. The irreversible outcome of a sleep-related death has no greater severity. The construct of perceived severity must also include

explanation of the possible outcome of seemingly harmless though decisively dangerous behaviors. Examples are bed sharing, lack of crib use, and infant positioning. It may seem logical to include these actions under perceived benefits, as they protect against SIDS and related deaths, but they are not actions resulting in positive effects. They are entirely preventive.

Perceived benefits. Similar to the perceived severity of sleep-related death, the perceived benefit is life. There are challenges to ensuring parents have the perception that preventive actions will save their baby's life, again, because SIDS is often perceived as having no known cause. Parents may believe the event strikes at random and actions to prevent SIDS are futile. Yet many interventions have benefits extending beyond SIDS prevention. Breastfeeding provides immunological support and protection from illness. Co-sleeping in the same room as the baby increases proximity of baby to mother and may increase breastfeeding frequency and duration.

Perceived barriers. Perceived barriers are a critical piece of the health belief model and of particular importance in this study. Barriers to instituting safe sleep environments are often grounded in racial disparity, which is difficult to overcome. Other obstacles are similarly intangible such as maternal education level, age, or income level. Yet all must be considered when administering a safe infant sleep program.

Use of the Health Belief model. The health belief model will be used to structure recommendations for Iowa birthing hospitals evidenced from the conclusions of this study. It is imperative that recommendations for Iowa hospitals come from Iowa mortality data as infant, maternal, and environmental characteristics may be different in Iowa compared to other states or even national trends. The health belief model addresses known barriers to following safe sleep guidance by requiring the consideration of the nature of SIDS (a death of unknown cause),

means to accomplish the intervention without sacrificing infant bonding, and disparities that affect the percent of parents and caregivers acting on safe sleep recommendations. The model also provides a construct with which the health beliefs of parents may be assessed following a health program.

Definitions of Key Terms and Acronyms

AAP- American Academy of Pediatrics

ASSB- Accidental suffocation and strangulation in bed

Bed sharing- situation where an infant is sharing a sleep surface with an adult or other child.

Co-sleeping- situation where an infant is sleeping alone on a separate surface, but in the same room as a parent or caregiver.

ICD 9- international classification of disease; used to code medical diagnoses, including causes of death

ICDRT- Iowa Child Death Review Team

IMR- Infant mortality rate

LBW- Low birth weight

ME- Medical examiner

Neonatal- the period of 0 to 27 days after birth

NICU- Neonatal intensive care unit

OB- Obstetric

Postneonatal- the period of 28 to 364 days after birth

Prone position- stomach down; frequently used to describe the positioning of infants on their stomach.

RN- Registered nurse

SIDS and related causes- to account for variance in medical examiner classification of sleep-related deaths, the term "SIDS and sleep-related causes" will be used. Deaths attributed to SIDS, asphyxia, undetermined and unknown cause fall into this category.

SIDS- Sudden infant death syndrome

Sleep-related infant mortality- any infant death classified as SIDS, asphyxia, undetermined or unknown where aspects of the infant's sleep environment may have contributed to death.

SUID- Sudden unexplained infant death; any infant death that may have suspected contributing factors (e.g., co-sleeping), but that has no definitive cause.

Supine position- back down; used to describe the positioning of infants on their back.

Summary

This chapter provides an introduction to the issue of SIDS and related mortality, the problem statement supporting research on the topic, research questions, and the conceptual framework used to structure this work. The following chapter includes a comprehensive review of current and past literature of the subject of SIDS and related mortality, protective and contributing factors, Iowa hospital distribution and description, evidence of past nursing practice, and validation of increasing concern for the use of unsafe sleep practices.

CHAPTER II

LITERATURE REVIEW

Sleep-related infant mortality encompasses a larger category than Sudden Infant Death Syndrome (SIDS). SIDS deaths are typically those without known cause; in recent years use of the SUIDS (Sudden Unexplained Infant Death Syndrome) acronym has increased despite only SIDS having an International Classification of Disease (ICD) code. Since the late 1990's, medical examiners shifted toward more frequent use of "Unknown" or "Undetermined" cause of death, which also has an ICD code. To best capture infant mortality associated with sleep environment, SIDS, unknown or undetermined deaths, and deaths attributed to asphyxia must be combined. For the purpose of this study, the term "SIDS and related" or "sleep-related" encompasses SIDS, asphyxia and suffocation, and undetermined or unknown events.

Literature on safe infant sleep typically refers to all three categories of sleep-associated mortality as "SIDS", though many articles specify events attributed solely to asphyxia in descriptions of risk factors external to the infant. The cumulative body of SIDS research is extremely comprehensive and has resulted in recommendations within every ecologic level of infant development. A multitude of study designs have been utilized, even qualitative analyses of maternal beliefs grounded in race (Moon et al., 2010). Professional medical organizations have published and revised safe infant sleep guidelines with regularity. More recent studies address continued or even increases in unsafe sleep practice and what may be a lack of prioritization by parents and caregivers around sleep practice.

The event of SIDS was not recognized until the early 1960's and was not defined until 1969 (Gilbert, 1994; Malloy & Ramirez, 2013). Previously, SIDS cases were classified as "respiratory illness", and though literature from that time period highlights the contribution of

respiratory illness to infant mortality, unexplained infant deaths were lumped into this category making epidemiologic surveillance prior to that time highly inaccurate (Carpenter & Shaddick, 1965). At present, SIDS is a classification used out of exclusion; to classify an infant death when exhaustive investigations including circumstances of death, autopsy, case and scene investigation, and clinical history review reveal no overt cause (Task Force on Sudden Infant Death Syndrome, 2011). SUIDS is used to describe a death that is both sudden and unexpected, but that may or may not be explained (Leach et al., 1999). SIDS falls under the category of a SUID occurrence that is unexplained. Deaths with known contributors, such as bed sharing, or cause, such as asphyxia, are still considered "sudden" and "unexpected".

Much of the research surrounding SIDS and the contribution of ecologic factors has been conducted at the national level. With enhanced surveillance efforts in the United States, observational cohort and case control studies have become more prominent (Broussard et al., 2012; Hirai, Hayes, Taualii, Singh, & Fuddy, 2013; Kieltyka, Craig, Goodman, & Wise, 2012; Krous et al., 2008; M. Smith et al., 2012). Studies have shown that incidence increases with higher longitude and more pronounced winters (Terence Dwyer & Ponsonby, 1992). Seasonality was certainly apparent throughout ecologic studies, but the effect has weakened with the decline in incidence that began in the early 90's (Leach et al., 1999).

Trends in infant mortality

"Infant mortality is defined as the death of an infant before his or her first birthday" and has long been a key indicator of population health (Barfield et al., 2013). The US infant mortality rate (IMR) has drastically declined since 1950 to 6.05 per 1,000 live births overall in 2011, yet remains three times that of countries with the lowest IMR. While substantial medical advances have increased survival rates for infants with a birth weight <1,000 grams from 10-

15% to >60%, percent of premature infants born in the US remains much higher than European countries thereby adversely affecting IMR (Barfield et al., 2013).

Recommendations for reducing the IMR for deaths categorized as SUIDS or SIDS include room sharing without bed sharing, breastfeeding, pacifier use, and immunizations (Barfield et al., 2013). The American Academy of Pediatrics (AAP) recommendations further address preventative deaths and will be discussed later in this chapter.

Trends in SIDS mortality

From 1992-2001 SIDS mortality decreased from 1.2 to 0.67 per 1,000 live births (Malloy & MacDorman, 2005). Since 2001, "there has not been a significant change in the rate of SIDS deaths", though deaths due to suffocation or undetermined cause from 2005-2008 have increased (Malloy & Ramirez, 2013; Schnitzer, Covington, & Dykstra, 2012a). Accompanying SIDS trend research are studies assessing contributory practices to SIDS and related death incidence. Multiple studies examining bed sharing, particularly those parsing behavior patterns by race and ethnicity, have detected alarming upturns in the practice. A National Sleep Position Study published in 2013 confirmed the finding that rates of bed sharing have increased since 1993 (Colson et al., 2013). Authors noted bed sharing grew from 6.5% in 1993 to 13.5% in 2010, but the rise was statistically significant for the period of 1993-2000 and not 2000-2010. Also prominent in this study was a racial breakdown of subjects as black, white, or Hispanic. Rates of bed sharing rose in all three groups from 1993 to 2010, with blacks experiencing an increase of 21.2% to 38.7%. Rates among Hispanics climbed eight percent during the study period. "Compared with white infants, black infants are 3.5 times more likely to share a bed and are more likely than any other race or ethnicity" (Colson et al., 2013). Other supporting researchers reported rates of bed sharing at 35.2% and among black mothers bed sharing occurred more than

30% of the time (Fu, Colson, Corwin, & Moon, 2008; Lahr, Rosenberg, & Lapidus, 2007). Another large study highlighted steady use of supine sleep positioning from 2000-2007 among non-Hispanic whites, but not among African Americans that were placing infants in non-supine positions more than 50% of the time (L. Smith et al., 2010).

A single qualitative study has attempted to ascertain why such a disparity between blacks and other racial and ethnic groups exists around safe infant sleep practices and beliefs. Moon, Oden, Joyner, and Ajao (2010) concluded that mothers did not draw the connection between safe infant sleep behaviors and SIDS, because SIDS is "when you don't know why the baby died". Vigilance was thought to protect against SIDS and may have an association with the use of bed sharing.

Demographic and social factors. Demographic profiles reveal that boys were more likely to die of SIDS than girls with a ratio of 60:40 (Moon, Horne, & Hauck, 2007). The gender difference has not been explained, but is a factor proven in most multivariate studies. Factors such as maternal smoking during or after pregnancy, lack of prenatal care, young maternal age, premature infant, and low birth weight add significant risk to the occurrence of SIDS (Task Force on Sudden Infant Death Syndrome, 2011). Social and racial disparities are prevalent in many societies. Families of low socioeconomic status or "high deprivation" experienced higher rates of SIDS prior to the supine (back down) sleep recommendation, but afterward saw a strikingly large increase in the odds ratio where families of "high deprivation" were 2.04 times more likely to experience a SIDS death in 1985-1990, then were 9.05 times more likely from 1997-2002 (Blair, Sidebotham, Berry, Evans, & Fleming, 2006; (Wood, Pasupathy, Pell, Fleming, & Smith, 2012). Interestingly, women within the category of "high-deprivation" experienced a more gradual reduction in the number of neonatal deaths when compared to

women of "low deprivation". A longitudinal study conducted in the United Kingdom and published in 2006 identified a similarly disconcerting trend. SIDS cases were still a major contributor to infant mortality, but were happening with increased frequency in deprived families (Blair et al., 2006). The proportion of infant deaths occurring in families with deprived social situations shifted from 47% in 1984-1988 to 74% in 1999-2003, and was significant with a p-value <0.003. Several factors interrelated with socioeconomic status are intrinsically more common in families of low status level. Maternal smoking during pregnancy, a solid contributor to SIDS risk, was reported as high as 87% ($p<0.0004$). The percentage of pre-term births in this same cohort was 34% ($p<0.0001$) (Blair et al., 2006). This study identified a target population for SIDS intervention and is a population that is mirrored in the US.

Race factors. Certain racial groups, though the race group affected differs by country, and frequently native populations, also have a disproportionate number of SIDS cases. Despite efforts to influence sleep positioning for more than twenty years, the rate of prone sleeping and bed sharing among African American households in the US remains nearly twice as high as other races as recently as a decade ago (National Infant Sleep Position study; Willinger, Hoffman, Kessler, & Corwin, 2003; Wood, Pasupathy, Pell, Fleming, & Smith, 2012). Therefore, rates of SIDS were found to be two to three times the US national average in black and American Indian/Alaska Native children (Task Force on Sudden Infant Death Syndrome, 2005).

SIDS and related mortality classifications

International Classification of Disease. The primary cause of death classification for SIDS, indicated by R95, is the International Classification of Disease code (version 10) used by forensic pathologists when all other causes of death have been ruled out (World Health Organization). It is not uncommon for pathologists to also use R99, which implies "other

symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified". Use of R99 became much more common after the shift from ICD nine to ten in 1999. Increased use of this category by medical examiners resulted in an artificial decline in the number of deaths coded as R95 in 1999 (Kochanek, Smith, & Anderson, 1999). Coding variance remains today; therefore, analyses of SIDS or sleep-related infant mortality include R95, R99 and also W75. The code W75 refers to "suffocation and strangulation due to: bed linen, mother's body, pillow" or accidental suffocation and strangulation in bed (ASSB); however, even in cases where this cause of death is suspected, medical examiners may list cause of death as "undetermined" (Barfield et al., 2013; Kemp et al., 2000; World Health Organization, 2010).

Forensic classification. There is great variance among forensic pathologists in the use of SIDS classification for infant deaths with unknown cause. The reduction in SIDS incidence since the early 90's has lowered the number of cases reviewed by medical examiners. A survey of medical examiners by the Department of Justice in 2004 revealed that less than 50% received an infant death case in that year and approximately 33% had policies for the investigation of SIDS cases (Camperlengo, Shapiro-Mendoza, & Kim, 2004). The lack of consistency across examiners of infant death, and particularly when the classification is one of exclusion, likely contributes to problems with specificity in death certificate data used to establish or adjust trends.

Child Death Reporting system. The *Child Death Review* (CDR) *case reporting system* was created in 2005. It is a national database of child death information that was developed and is currently maintained by the Michigan Public Health Institute (Michigan Public Health Institute, 2011). CDR is utilized by nearly all states (Michigan Public Health Institute, 2011). The Iowa Office of the State Medical Examiner (IOSME) enters all child fatality cases into the

CDR. The system is not centered on ICD codes drawn from death certificates, but contains the primary cause of death (Michigan Public Health Institute, 2011). A multitude of information is included on every case within this system. The CDR captures excellent data on cases of sleep-related death and was the data source used for this study.

Infant sleep environment

The strongest predictive risk factors for SIDS, asphyxia, and undetermined infant deaths are related to sleep environment. Analyses of infant sleep environments typically involve position, sleep surface, location (e.g., crib, bassinette, adult bed), and the presence of objects in the sleep space.

Sleep position. Sleep position was confirmed as a major contributor to SIDS risk in the late 1980s and served as the impetus for supine sleep recommendations (T Dwyer, Ponsonby, Newman, & Gibbons, 1991). "Back to Sleep" began about three years prior to the US in other countries and has been closely monitored in the United Kingdom (Blair et al., 2006; Brooke, Gibson, Tappin, & Brown, 1997). A similar decline in prone sleep positioning and SIDS incidence has been documented (Blair et al., 2006). The prevalence of prone sleep prior to "Back to Sleep" is not well known; however, studies shortly after 1994 show rates of approximately 40% of parents using prone sleep and gradual declines thereafter (Brenner et al., 1998).

Parental positioning of infants has been studied in clinical settings and as part of postpartum surveys with a wide range of results. A 1998 study of inner-city infant care practices identified a rate of exclusive back sleep of only 16% (Brenner et al., 1998). Parents intending to use prone sleep position were concerned about their infant choking, but among those who ended up using stomach sleep, 60% cited infant preference as the reason. Another more recent study

had similar results also noting that 60% of parents using prone sleep chose prone sleep positioning because their baby slept better, while 12.5% stated choking risk was the primary reason (Zachry & Kitzmann, 2010). Moon and Omron (2002) found that 15% of African American parents were using prone sleep positioning, but had bed sharing rates of 48%. These surveys have also focused on demographic factors that help determine what types of caregivers should be targeted for safe infant sleep interventions. Dominant factors included black race, young maternal age, low educational attainment, single parent, and low-income status (Brenner et al., 1998; Schnitzer et al., 2012b; Zachry & Kitzmann, 2010). Studies examining parental placement of infants for sleep rely on parental response survey data, as observation is not feasible for large cohorts. These data are subject to respondent bias, therefore, it is possible that actual rates of prone sleep positioning could be higher than reported.

Sleep surface. According to the Task Force on Sudden Infant Death Syndrome (2011), infants should be placed on a "firm surface" keeping soft objects and loose bedding out of the crib. Deaths due to asphyxia frequently involve unsafe sleep surfaces such as couches, chairs or adult beds (Schnitzer et al., 2012b). Pillow use has also been cited as an increased risk factor for SIDS (Thompson, Thach, Becroft, & Mitchell, 2006). Of infants sharing a bed with an adult, most are sharing their sleep surface on an adult mattress (Colson et al., 2013). On a positive note, the same study found that use of quilts or comforters has greatly declined since 1993 from 41% to eight percent in 2010.

Co-sleeping and bed sharing. A distinction must be made between co-sleeping and bed sharing. Co-sleeping refers to infants and parents or caregivers sleeping in the same room, but on separate sleep surfaces. Bed sharing is as the term infers; parents and infants sharing the same sleep surface. According to a 2012 review of birth and death certificate records, 9.2 infants

die of accidental strangulation or suffocation for every 100,000 live births (Carlberg, Shapiro-Mendoza, & Goodman, 2012).

Bed sharing cultural practices varies internationally. Bed sharing with infants at three months of age was recently reported by approximately one-quarter of parents in European countries such as Germany, Scotland, Italy, Austria and Ireland and reached as high as 65% in Sweden (Nelson et al., 2001). Bed-sharing was much less common in the US, which in 2000 had a rate of 12.8% (Willinger, Ko, Hoffman, Kessler, & Corwin, 2003).

Bed sharing was thought to facilitate emotional bonding between the infants and parents, especially breastfeeding mothers. It was convenient for breastfeeding mothers and resulted in more frequent nursing sessions that were longer in duration (Blair, 2010). The benefit of better breastfeeding practices created quite a quandary for researchers once bed sharing was identified as a risk factor for SIDS.

Studies with outcomes in favor of bed sharing (without examining the risk of SIDS) were countered by other researchers who cited the detrimental effects of the habit such as parents rolling over on top of infants, soft bedding, suffocation, and a general increased risk of SIDS (Weber, Risdon, Ashworth, Malone, & Sebire, 2012). Researchers have considered different sleep environments and arrangements including sleep with another person >1 year of age and a shared sleep environment (e.g., bed, couch, reclining chair). Measures of association were stratified by the different types of sleep environments. An alternative to bed sharing was encouraged by the AAP in 2005 and reiterated in 2011. To promote breastfeeding without jeopardizing infant safety; infants should sleep next to the parent's bed though in a separate bed (Task Force on Sudden Infant Death Syndrome, 2005, 2011).

Contributory and protective factors

Protective factors. The literature includes protective factors which, when employed with infants, reduces the risk of SIDS. Breastfeeding was demonstrated as a protective factor, though this variable was frequently the subject of indifference until confirmation in recent years. Much of the debate on this protective factor centered on plausibility of the protective effect or mechanism by which breastfeeding would protect and infant. Challenges associated with measuring independent variables included how to accurately assess frequency of feeding, duration of nursing time, and exclusivity. Studies confirmed that breastfeeding does provide a protective effect that is strongest when done exclusively and for at least six months (Hauck, Thomson, Tanabe, Moon, & Vennemann, 2011). Another protective factor cited in literature was pacifier use. Pacifiers were recommended for use in infants by the AAP, though the means of protection was not known (Task Force on Sudden Infant Death Syndrome, 2011).

Factors with null effect. Over the last decade, multiple commercial products purporting to prevent SIDS or lower SIDS risk have been marketed to parents of infants. Products included sleeping wedges, fans, and home cardiorespiratory monitors. Sporadic studies initially supported the use of fans and wedges as a way to slightly lower risk, but the efficacy of those products was not confirmed in subsequent examinations. Home cardiorespiratory monitors, not for medical use, but for the monitoring of healthy infants, were also thought to protect against risk when first introduced. Case control studies of the devices did not prove any advantage over controls where no monitoring was performed. As a result, the AAP warned against the use of all three of these items as they were not scientifically proven to lower SIDS risk (Task Force on Sudden Infant Death Syndrome, 2011).

Ecologic factors. *Triple-threat hypothesis.* SIDS has been the focus of extensive research, though to date no uniform etiology has been identified that explains all cases. A leading hypothesis describes the "triple threat"; a series of criteria that, when met, may result in a SIDS death. This hypothesis is a useful model for organizing current knowledge and a valuable framework to use in constructing new hypotheses. The three factors comprising the "triple threat" include, 1) a susceptible infant, including a general factor that increases death from any cause (e.g., low socioeconomic status prematurity, male gender, African American race), 2) a critical developmental period in homeostatic control (normal physiologic state) or risks related to the infant's developmental status, and 3) an exogenous stressor or precipitating factor (e.g., sleep position or infection) (Filiano & Kinney, 1994; Guntheroth & Spiers, 2002). SIDS incidence is highest during months 2-5, a period of critical development, and risk decreases in succeeding months (Leach et al., 1999).

Ambient air temperature and weather patterns. The influence of ecologic factors falls under the third component of the "triple threat" hypothesis. Examination of the influence of ecologic factors on SIDS events has been conducted with limited identification of definitive risk factors. Common themes in ecologic studies of SIDS included weather patterning, the influence of temperature and humidity, and parental response to fluctuations in temperature (Fleming, Blair, & Fleming, 2000; Schluter, Ford, Brown, & Ryan, 1998). Thermal stress induced by spikes in ambient air temperature has repeatedly been tested as a cause of increases in SIDS in various studies without validation (Scheers-Masters, Schootman, & Thach, 2004). Hyperthermia in infants manifests through multiple ecologic situations including extremely high ambient air temperatures, overwrapping infants with clothing or bedding, or laying infants in the prone position, which impaired their ability to release body heat. Thermal stress may play a role in

susceptibility to infection as Gilbert (1992) demonstrated that the risk of infection was greatest when infants are overdressed, despite the absence of clinical symptoms of illness.

Infectious diseases. Infectious diseases, particularly viral and bacterial respiratory infections, have a hypothetical role in SIDS deaths, but the extent to which these infections cause death or contribute to death is still unclear (M. L. Harris et al., 2012; Mage, 2004). It is possible for subclinical infections to result in serious, even fatal outcomes and to remain undetected following death. Limitations to researching the contribution of infectious disease include the inability to distinguish between colonization and acute infection, constraints in disease specimen viability, and proportionate attribution to causing death (Blood-Siegfried, 2009; M. L. Harris et al., 2012).

Role of thermal stress. The balance between exogenous heat production and heat loss is precarious in infants (Guntheroth 2000). Infants respond to stimuli much in the same way as older children in that certain influences ramp up metabolism and therefore heat production. These influences include convection, shivering response, sleep state, and consciousness. When the infant's internal temperature rises, the ability to lose heat as a means to regulate body temperature is critical. Heat loss is impeded in infants when they are placed in prone position, or are overwrapped in clothing or blankets. In addition, factors external to the infant may also impact internal temperature such as ambient air temperature and proximity to heat source, including human sources like adults and other children. With the exception of excessive bedding or wrapping the infant and febrile illness, not all of the aforementioned factors have calculable contributions in the literature, (Gilbert et al., 1992).

One study reviewed fluctuations in nighttime infant body temperature and concluded that temperature change in infants was associated with host response, or infant response to stimuli,

which do not always include infectious agents (Jackson, Petersen, & Wailoo, 1994). In summary, the researchers were able to demonstrate that infant exogenous heat production may increase in response to something similar to immunization, which evokes a mild temperature increase. However, the authors also concluded that temperature spikes were strongest in the three days prior to clinical symptoms of an infection (Jackson et al., 1994). Infections, particularly non-obvious respiratory infections, are known to have a role in SIDS occurrence.

Parental perception of temperature impacts manipulation of the environment. In other words, parents cognizant of cold outdoor temperatures may overcompensate with clothing or supplemental heat sources in an infant's room (Terence Dwyer & Ponsonby, 1992). Several studies confirmed that a temporary rise in cases of SIDS and related deaths is linked to hyperthermia relative to overheating and overdressing infants in response to cold ambient air temperatures. (Guntheroth, 2001; Jones, Ponsonby, Dwyer; Gilbert, 1994).

Role of health care

Routine infant care instruction is primarily provided by hospital nursing staff in the period following birth. The average hospital stay is just 1.6 days or 39 hours (Farhat & Rajab, 2011). Hospital stay may be extended if an infant experiences adverse health outcomes such as jaundice, meconium aspiration, or detection of a birth defect.

Health professionals have a significant impact on the infant care practices of parents. Infants are more likely to be placed on their back to sleep if recommended by a health care provider (Moon & Omron, 2002). Maternal perception of physician qualification to give advice on sleep positioning affects maternal actions. Smith, et al (2010) found that mothers are more likely to consider physicians better qualified to give advice regarding fever, vaccinations, and feeding as opposed to safe sleep positioning or bed sharing. However, the odds of a mother

following physician advice regarding safe infant sleep were twice as high when the physician was perceived as extremely qualified to give advice (L. Smith et al., 2010). The likelihood of exclusively supine advice varies by source with doctors most often providing such advice followed by nurses, the media, family, and friends (Von Kohorn, 2010). Even among physicians and nurses, only 56 and 44% respectively recommend only supine positioning. These data were supported by another study that found only 69% of doctors advised supine sleep (Moon et al., 2007).

Several studies emphasize the criticality of teaching and modeling behavior. Parents that observe health care professionals placing infants prone or on their side are more likely to infer that supine positioning is not important (Moon et al., 2010). Another study found that the majority of parents that reported receiving advice from a physician or nurse about supine sleep and saw the practice demonstrated were likely to choose that position (Colson et al., 2001). It is also imperative "for health care providers to deliver multiple, varied, and consistent safe sleep messages at all encounters, beginning prenatally and continuing throughout the infant's first few months of life" (Mason et al., 2013).

Beliefs and practices of nursing staff

The first "Back to Sleep" recommendations were provided by the AAP, US Public Health Service, and SIDS Alliance in 1994, and while supine sleep was emphasized, side sleep was not discouraged (Hein & Pettit, 2001). As a result, many hospital nursing staff felt it appropriate to continue use of side sleep. Rationale for use of non-supine sleep positions among nursing staff has been studied with findings that aspiration is the most common concern (Aris et al., 2006; Hein & Pettit, 2001). Strong evidence exists that neither reflux or risk of aspiration following feeding support use of non-supine sleep (Byard & Beal, 2000; Malloy, 2002). Alarmingly,

studies of nursing practice in hospitals have revealed rates of 79% using side sleep and only 20% supine (Colson & Joslin, 2002). Other studies reported nursing staff positioned infants in the supine position at rates of 37% with side sleep dominating again at 50% (Colson et al., 2001).

Aside from fear of aspiration, nursing staff behaviors were likely influenced by AAP policy. In 2000, the AAP advised that supine sleep was the preferred position, but if side position was used, the dependent arm should be brought forward to reduce the likelihood of rolling over (Task Force on Sudden Infant Death Syndrome, 2005). The absence of an absolute recommendation for supine sleep most likely resulted in these practices among nursing staff. It was not until 2011, following multiple conclusive studies that side positioning was unstable and increased the risk of SIDS, that the AAP changed their recommendations to supine exclusivity (Moon, 2011).

Neonatal intensive care nursing and low-weight babies

Low-birth weight (LBW) babies are at increased risk for SIDS and related deaths (Malloy & Freeman, 2000; Malloy, 2013). A significant contributor to this elevated risk is parental behavior resulting from observation of prone positioning in the NICU. Prone positioning of LBW infants has been shown to maximize respiratory mechanics (Gouna et al., 2013). Nursing staff concern for aspiration also promotes prone positioning of LBW infants even when preparing for discharge (Aris et al., 2006; Hein & Pettit, 2001). In reviews of nursing practice, slightly more than 50% of nurses instruct parents to place infants on their backs after discharge (Aris et al., 2006).

Studies show that the recommendations of physicians and nurses affect parental behavior (Willinger et al., 2003). As with non-LBW infants, reinforcing verbal guidance with demonstration is the most effective way to ensure parental compliance (Colson et al., 2001).

Multiple studies and the AAP have outlined the importance of transitioning LBW infants to supine sleep before discharge and providing education to parents (Esposito et al., 2007; Gelfer et al., 2013).

Maternal practices of infant care

Ateah and Hamlin (2008) conducted a review of maternal attitudes on bed sharing and found that more than 70% "agreed it was natural for mother and baby to sleep in the same bed". Respondents in the study reported regular bed sharing 42.7% of the time, and one third shared their bed with their infant occasionally. However, of those that bed shared, 30% did so the entire night. The authors did not find differences in the prevalence of bed sharing "with respect to maternal age, education, family income, or marital status" (Ateah & Hamelin, 2008). Other notable findings were that breastfeeding mothers were twice as likely to bed share. Interestingly, of all respondents, most agreed that sleeping with an infant was a risky behavior.

Other research on bed sharing indicates the same factors are present for increased risk of SIDS as for the practice of bed sharing. Non-Hispanic blacks or American Indians are more likely to experience an accidental strangulation or suffocation of an infant. Additionally, young, less educated, multiparous women, particularly those who smoke, are at elevated risk for infant death related to bed sharing (Carlberg et al., 2012).

A study of maternal sleep practices for infants 0-6 months found striking prevalence of bed sharing at 48% among African Americans in the District of Columbia (Moon & Omron, 2002). This finding is similar to rates among African Americans that have experienced a sleep-related death in Iowa. A review of sleep-related deaths from 2004-2011 revealed infants were sharing a sleeping surface with an adult or child nearly 40% of the time at time of death (M. Harris, 2014). Neither study determined underlying causes for bed sharing, but the parents in the

Iowa review were likely to be high school educated and receiving Title 19 benefits. Therefore, socioeconomic status, and possibly the inability to purchase a crib contributed to the prevalence of bed sharing.

Child death review teams

Child death review teams provide an important investigative and localized connection between SIDS deaths and potential interventions. Aforementioned differences in cultural practice, racial and ethnic disparities, and socioeconomic status may be best studied and acted upon at the community level. The first child death review team (CDRT) was formed in Los Angeles County, California, in 1978, while most state teams were not conceived until the mid-1990's (Hochstadt, 2006). CDRTs first formed to review cases of suspicious deaths for the potential involvement of abuse or neglect, but have shifted toward a prevention model rooted in public health that revolves around the "systematic review of child deaths from birth through adolescence" (Christian & Sege, 2010). State teams vary in structure, but have a common purpose. Hochstadt (2006) provides the following description of review teams:

> The primary goal for all child death review teams, regardless of their composition, is preventing child death and serious injury through an interdisciplinary review of cases. Child death teams attempt to understand cases of preventable death rather than assign blame and to uncover ways that child welfare systems (e.g., child protection, public health, juvenile justice) can be improved to prevent future deaths or injuries.

It is the diverse nature of these teams that brings a wealth of experience and insight to the process. Throughout the evolution of purpose from case finding to prevention, diversity in member composition remains a defining attribute of these teams.

The Iowa Child Death Review Team

The Iowa Child Death Review Team (ICDRT) was formed in 1995 via Iowa Code 641—90.1(135) (Iowa Legislature, 2010). The team is comprised of people from various disciplines including law enforcement, a state forensic pathologist, director of the Iowa Office of the State Medical Examiner (IOSME), social workers, including several from Iowa schools, a representative from the Department of Health and Human Services, the insurance industry, the coordinator for the Iowa SIDS Foundation, an epidemiologist, and support staff from the Iowa Department of Public Health (IDPH), all appointed by the Chief State Medical Examiner (Gehrke, 2009; Iowa Legislature, 2010). While the makeup of the ICDRT is defined in Iowa Code, the composition of Iowa's team aligns with what is suggested by the National Maternal and Child Health Center for Child Death Review (Iowa Legislature, 2010; Shanley, Risch, & Bonner, 2010).

The team's responsibilities are outlined in code as well and are to:

> …Aid in the reduction of preventable deaths of children under the age of 18 years through the identification of unsafe consumer products; identification of unsafe environments; identification of factors that play a role in accidents, homicides and suicides which may be eliminated or counteracted; and promotion of communication, discussion, cooperation, and exchange of ideas and information among agencies investigating child deaths. (Iowa Legislature, 2010)

The team is charged with drafting recommendations and developing an annual report distributed to the governor and general assembly, agencies, public, media and any person involved with "child protection interventions" with the intent of preventing child deaths based on the analysis of such deaths (Iowa Legislature, 2010).

Another critical component of the ICDRT is data collection. In an effort to maintain the most complete files for each event, supplemental information (e.g., medical records, child welfare reports) is requested on each case. Records may originate from agencies outside of the IOSME and most often include contact with the Department of Public Safety, Department of Human Services, local law enforcement, health care providers, local death investigation records, and IDPH. These records are not always readily accessible, despite extreme value in assessing trends in child death events. In some cases adjudication, or impending trial, prevents the release of records. Staff from the Bureau of Family Health at IDPH and IOSME solicits this supplemental information to support mandatory reports submitted to the IOSME on every child fatality. The process is arduous and time consuming and all staff time is provided in-kind.

Investigation of most child death events in Iowa occurs at the local level and is often conducted by law enforcement, county medical examiners, social workers and health care providers. Child death cases under the responsibility of IOSME are investigated by a state medical examiner and medical examiner investigator (MEI). Some local cases are also investigated with the help of IOSME, often a MEI.

Structure and classification of the Iowa hospital system

The number and location of urban areas and a preponderance of critical access hospitals largely define Iowa's hospital network. Iowa has two level one trauma centers, and three level two trauma centers (American College of Surgeons, 2014). Level one facilities have advanced neonatal care capabilities as well as specialized traumatic units required by the American Trauma Society for classification (American Trauma Society, 2014). In total, Iowa has 117 hospitals, all of which are non-profit or government owned (Table 2.1) (American Hospital Association, 2011).

Table 2.1

Ownership categories of Iowa hospitals, 2011

Ownership	Iowa	Midwest	United States
For-profit	0.0%	7.7%	19.9%
Government-owned	50.0%	34.4%	21.8%
Non-profit	50.0%	57.%9	58.3%

A vast network of 82 critical access hospitals (CAH) provides much-needed infrastructure in Iowa's rural counties resulting in no Iowan being more than 25 miles from a hospital (Iowa Hospital Association, 2009). Federal funding supplements infrastructure needs and stabilizes budgets for CAH with the intent of ensuring equitable access to routine and emergency care in all areas of the state. CAH have 25-bed maximum capacity (Centers for Medicare and Medicaid Services, 2013). According to the Iowa Hospital Association in 2009, 79 hospitals have a birthing suite or labor and delivery capabilities and 78 have obstetrics clinicians on staff. However, more recent information from IDPH confirmed only 70 hospitals have birthing suites or labor and delivery capabilities as of 2014. Challenges in maintaining obstetrical staff as well as profitable maternity units has motivated mid-size and critical access hospitals to stop supporting deliveries (Iowa Hospital Association, 2009). Though CAH must have 24-hour emergency services, providing routine obstetrical service is not a requirement (Centers for Medicare and Medicaid Services, 2013).

Safe infant sleep education programs

Level C recommendations from the AAP include the statement that "health care professionals, staff in newborn nurseries and NICU's, and child care providers should endorse the SIDS risk-reduction recommendations from birth". As previously mentioned, hospital nursing staff have critical and influential interactions with the parents of newborns, so they

themselves must be educated on practices and communication that reduces risk. According to one study, approximately half of birthing hospitals may have a policy addressing sleep position; however, it is not apparent whether researchers have studied forms of nursing education correlated to practice and infant survival outcomes (Bullock et al., 2004). Several efforts have to bring safe infant sleep education to the nursing environment have included algorithms for introducing safe sleep education in the NICU. Examples are the Plan-Do-Study-Act intervention cycle, the option for Train the Trainer, and computer-based education and training (Gelfer et al., 2013; Mason et al., 2013; Price et al., 2008).

Continuing education programs are one of the primary means to promote safe, appropriate nursing practices for the care of infants focused on SIDS prevention. In 2007, the National Institute of Child Health and Human Development and National Institute of Nursing Research, along with many other collaborators developed a curriculum emphasizing "the most current research findings and theories about SIDS and provides nurses with practical approach to communication about SIDS in a multi-cultural environment" (National Institutes of Health, 2007). The program is available free online or may be ordered without charge and provide 1.1 continuing education credits for nurses following completion of the two-session course (Eunice Kennedy Shriver National Institute of Child Health and Human Development, 2013).

Summary

An exhaustive number of studies have attempted to identify a uniform cause for SIDS and while an incredible amount of information has flooded education for parents, caregivers, nurses, and other health professionals, no single cause exists. There are factors that increase SIDS and related cause risk that have been identified for parents of infants and for the family structures into which infants are born. Important racial and ethnic disparities remain despite

more than two decades of supine sleep initiatives. The best-known prevention measures are related to sleep environment and positioning and have resulted in the largest declines in SIDS, asphyxia and unknown infant fatalities. Child death review teams are imperative for providing a localized perspective, real-time analysis of population trends, and recommendations including factors specific to the team's jurisdiction. Much work has been done on evaluating nursing practice in birthing hospitals, including a paramount study in Iowa in 1998 (Hein & Pettit, 2001). There is a need to determine the current state of safe infant sleep nursing practice as multiple studies have not supported a longitudinal reduction in unsafe practice, nor have researchers attempted to correlate practice with incidence. By doing so hospitals and nursing staff may benefit by having an understanding of the potential impact of their actions, programs, and policies.

CHAPTER III

METHODOLOGY

The purpose of this study was to examine potential correlations between safe infant sleep education practices in birthing hospitals and incidence of infant mortality attributed to unsafe sleep environments, as well as provide descriptive analysis of sleep-related mortality. The conceptual framework used for this research is Bronfenbrenner's ecological model of human development allowing for relational analysis amongst levels of interaction with the child throughout the course of development. This model allowed for inclusion of multiple interrelated factors that account for both direct and indirect interactions with the child. This approach provided a more complete overview of the problem under review, integrated past research, and structured opportunity for future work. Additionally, the results from this study will be used to inform the Health Belief Model, used to evaluate health programs.

This chapter provides a description of the selected epistemology inherent to the theoretical perspective and accompanying methodology. Detailed methods will specify the plan of action for this study, including sampling and querying tools, measurement, and statistical analyses.

Philosophical assumptions and research design

Epistemology is the science or nature of knowledge (Beisser, 2013). Establishing philosophical grounding enables the determination of what kinds of knowledge are possible and to what extent, furthering accuracy and legitimacy (Crotty, 1998). Objectivist epistemology "holds that meaning, and therefore meaningful reality, exists as such apart from the operation of any consciousness" (Crotty, 1998). As explained by Crotty (1998), objectivism is the view that

"things exist as meaningful entities independently of consciousness and experience". Thorough study of the presence of meaning and truth in people (objects) under study will allow revelation of untainted truth and meaning. Objectivism is appropriate for empirical research and reflects the tenets of research when guided by the following principles:

1. Use of a solid research design.
2. The researcher must be competent to conduct the research.
3. Consequences of the research must be identified.
4. The sample selection must be appropriate for the purposes of the study, representative of the population to benefit from the study, and in sufficient number.
5. The participants must agree to participate in the study through voluntary informed consent.
6. The researcher must inform the participants whether harm will be compensated. (Creswell, 2013)

With objectivist epistemology set, theoretical perspective must be addressed. Positivism includes assumptions that an objective reality exists and can be measured using appropriate variables and thereby outcomes (Butin, 2009). The positivism principle of verifiability "means that no statement should be taken as truth unless empirically verified or at least until it is capable of being verified" (Ozmon & Craver, 1976). The positivist attitude stems from confidence that science is accurate and certain, and is therefore the appropriate theoretical perspective for this study.

Methodological approach

The methodological approach for this study is experimental and based on correlational, cause and effect relationships between safe sleep education and SUID events. While

experimental, it is an observational, descriptive study cross-sectional in nature as data were drawn from a single point in time from a large, but defined population (Oleckno, 2002). The analysis of infant mortality data was retrospective, but still supported the cross-sectional study design. The dependent variable of sleep-related death incidence was influenced by multiple external factors narrowed to those pertaining to safe sleep environment. An experimental study is intended to demonstrate dependent and independent variable relationships through the manipulation of those variables (Salmons, 2010).

This approach was used in establishing baseline and contextual characteristics of infant mortality in Iowa and was used in performing correlations and regression modeling with dependent variables to the outcome of SIDS and related causes of death. A grouping of independent variables was drawn from the types of safe sleep education currently provided at birthing hospitals as well as indirect influences such as policies and staff training.

The survey research methodological approach was employed in distributing a statewide questionnaire to unit coordinators at birthing hospitals. This survey captured hospital-specific data on safe sleep parent education practices, hospital policies, and staff education opportunities.

Methods

Participants and sampling

Infant mortality cases. No case selection strategy was used for this component of the study as is appropriate for a cross-sectional design. Cases selected for inclusion in this study met the following criteria:

1) Child less than 365 days of age at time of death
2) Fatality occurring from 2004 through 2012
3) Resident of Iowa at time death

4) Cause of death classification available

5) Fatality event included in the Child Death Review case reporting system

Two cohorts were created from the original sample—one consisting of infants with any cause of death classification and a second with only infants assigned death due to SIDS, asphyxia, or undetermined or unknown cause.

Deviation from International Classification of Disease (ICD) coding. Death certificate causes of death are assigned using ICD-10 codes. ICD-10 codes are not stored in the CDR system, but cause and manner of death are captured (National Center for the Review and Prevention of Child Deaths, 2013a). Additionally, deaths with a cause assignment of SIDS, asphyxia, or undetermined or unknown cause where death occurred while sleeping are coded according to whether the death was related to sleeping or the sleep environment. A positive response to that question results in the collection of a series of questions on the sleep environment.

All cause infant sample. The all cause sample included all general parameters previously stated. All cases in the CDR system have an assigned cause of death; therefore, none were excluded due to missing data. The resulting size for this sample was 1,842. However, tests for normality and preparation for inferential statistics required the removal of variables for infant and maternal characteristics with missing or unknown responses. According to Tabachnick and Fidell (2012), dropping cases is acceptable when data are missing for only a few cases and those cases missing data appear to be random. In this instance, the majority of cases in the original sample of 1,842 were assigned a cause of death due to congenital anomaly. Excluding cases with missing infant and maternal demographic data resulted in a more even distribution of cases across causes. The reduced the sample size was 293. One important limitation of this dataset

was sleep environment data were not available for cases where cause of death was anything other than sleep-related. Therefore, analyses related to sleep environment at time of death as predictors of a sleep mortality outcome were not possible.

Sleep-related cause infant sample. A second sample created was limited to cases with a sleep-related cause of death for a total of 384 cases. These cases were used in multiple frequency analyses. Cases with missing or unknown values were excluded for inferential two-way contingency analyses resulting in 151 total cases.

Hospital survey participant sample. The Iowa Hospital Association (IHA) categorizes hospitals into four types by increasing bed capacity- critical access (limited to 25 bed maximum), rural, rural referral, and urban. The majority of Iowa hospitals are critical access, located in rural counties, followed by urban, rural and rural referral. Rural and rural referral hospitals have increasing bed capacity and advanced medical services. Urban facilities are categorized by trauma system level. Differentiation in trauma system levels is irrelevant to this study.

Of the 117 hospitals in Iowa, 70 have maternity units. Maternity unit coordinators are the most likely to be familiar with unit nursing practice, hospital policies, and training related to around safe infant sleep. The Iowa Department of Public Health (IDPH) Maternal Health program maintains contact information for all OB unit coordinators. All 70 Iowa birthing hospitals were included in this study.

Sample size requirements

All cause infant cohort. The sample size required for this study was based on the maximum use of eight independent variables and in order to most effectively conduct correlations and logistic regression is based on the formula $N \geq 50 + 8m$, where N= sample size of 114; $m = 8$, the number of independent variables (Tabachnick & Fidell, 2012). The maximum

available sample size without case de-selection for missing responses in the all-cause infant sample was 1,842. The minimum number of available cases excluding for missing responses for any variable used in the analyses was 293. Therefore, de-selection for missing data occurred for inferential analysis.

Sleep-related cause infant cohort. The sample size required for this study based on the maximum use of two independent variables and in order to most effectively conduct correlations and logistic regression is based on the formula $N \geq 50 + 8m$, where N= sample size of 66; $m = 2$, the number of independent variables (Tabachnick & Fidell, 2012). The maximum available sample size without case de-selection for missing responses in the all-cause infant sample was 384. The minimum number of available cases excluding for missing responses for any variable used in the analyses was 151. Therefore, de-selection for missing data occurred for inferential analysis.

Hospital survey participant selection. No case selection strategy was used for this component of the study as was appropriate for a cross-sectional design. Participants for this project were drawn from the 70 birthing hospitals in Iowa, despite the potential for hospitals without birthing units to perform occasional deliveries. Facilities without birthing units were excluded because they were unlikely to have SIDS or safe infant sleep policies, routinely perform education with parents of newborns, or support training of clinical staff on safe infant sleep.

Sample size. Sample size requirements were not applicable for the hospital survey as only descriptive statistics were used in the study.

Data collection procedures

Multiple data collection methods and sources were used for this study, including existing databases and survey data.

Infant mortality data. Infant mortality data for analysis of sleep-related mortality incidence were acquired from the Child Death Review (CDR) case reporting system. The Iowa Office of the State Medical Examiner (IOSME) collects reportable information on every child fatality. These data are entered into the CDR system and are available for extract by the ICDRT analyst and IOSME staff. Due to pending litigation, lag time in gathering reports, and delays in data entry, data are typically available 18 months following the end of a calendar year. Data used for this study will extend from 2004-2012 as those are the only years with complete information in the CDR system.

The CDR system houses an extensive amount of data in more than 20 separate reporting tables with 2,015 variables (National Center for the Review and Prevention of Child Deaths, 2013a). All tables and variables were kept for the all-cause infant cohort, though only a small subset were used in analyses. For the sleep-related cause cohort, tables were limited to: Child information, primary caregiver information, incident information, official manner and primary cause of death, and other circumstances of incident (National Center for the Review and Prevention of Child Deaths, 2013b).

Quantitative survey. A web-based questionnaire developed in Qualtrics® was distributed to obstetric unit coordinators at all 70 Iowa birthing hospitals (Appendix A). Introductory text indicated the nature of the survey, intended use, methods for removing any facility identifiers, ability to request facility-specific results, informed consent instructions, and survey purpose and publication intent. The only respondent identifier collected was email address. The survey

content was centered on existing nursing practice, parent education, nursing demonstration, hospital policy, and clinical staff education opportunities pertaining to safe infant sleep environments.

Survey pilot. The survey was piloted with a group of epidemiologists, maternal health program directors, members of the Iowa Child Death Review Team, and the director of the Iowa SIDS Foundation. Feedback was received and incorporated in the survey before release.

Survey distribution. The survey was distributed by email to all 70 obstetric coordinators of Iowa birthing hospitals. The survey was made available for 10 days. Multiple reminder emails were sent to the respondents and the survey was kept open an additional four days to allow further response.

Incentives were not offered to participants, though a copy of the final survey results will be provided to all respondents who gave an email address.

Supplemental data sources. Several supplemental data sources were used to augment data needed for this study. Birthing rates obtained from the International Cesarean Awareness Network of Northeast Iowa were reviewed for Iowa hospitals to determine what hospital type had the largest number of deliveries and are available in Appendix B (International Cesarean Awareness Network of Northeast Iowa, 2010). Descriptive hospital data were secured from the Iowa Hospital Association detailed hospital type and facility classification (e.g., critical access hospital) (Iowa Hospital Association, n.d.). These data were used to examine responses by hospital type. Live birth statistics from IDPH were used to calculate mortality rates (Iowa Department of Public Health, Bureau of Vital Statistics, 2013). OB coordinator contact information, including email addresses used for survey distribution, was provided by IDPH (Iowa Department of Public Health, 2013).

IRB. An application to IRB for this study was submitted in May, conditionally approved, and received full-board approval in June 2014. Changes to the study structure or questionnaires were submitted to the IRB in September 2014.

Data analysis procedures

SPSS® software was used to calculate all descriptive and inferential statistics for this study.

CDR system data adjustments

Multiple adjustments were made to the infant mortality data for better constructs in all analyses. Morgan, et al (2013) cited nominal variables are not appropriate for inferential statistical analysis. However, variables may be transformed into dichotomous variables when appropriate. Several maternal and environmental variables were nominal and required transformation into dichotomous variables. One new construct was created for both cohorts—cause of death, a dichotomous variable either not sleep-associated or sleep-associated based on the original CDR question of whether the death was "related to sleeping or the sleep environment" (National Center for the Review and Prevention of Child Deaths, 2013a).

All cause infant cohort. For the all cause infant cohort, race group and maternal employment status were collapsed into dichotomous variables at the same time that cases with unknown or missing variables were excluded. Race group options were changed to "non-white" or "white", and maternal employment status options were changed to "employed" or "not-employed". All were nominal before the transformation. As previously stated, the resulting sample used for inferential analyses was 293 (Table 3.1).

Table 3.1
Descriptive Statistics for the All-Cause Infant Cohort (n=293)

Variable	Type	*n*	Mean	SD	Min	Max
Maternal age at infant death	IV	293	25.80	5.95	15	45
Maternal education level[a]	IV	293	2.18	.72	1	4
Maternal employment status[b]	IV	293	.624	.49	0	1
Days alive	IV	293	80.12	86.6	0	359
Infant race[c]	IV	293	1.20	.40	1	2
Infant sex[d]	IV	293	1.40	.49	1	2
Number of children living with decedent	IV	293	1.24	1.36	0	8
Cause of death[e]	DV	293	.48	.50	0	1

Note. a Ordinal: 1 = Less than high school, 2 = High school, 3 = College, 4 = Post graduate
b Nominal: 0= Unemployed/stay-at-home, 1=Employed
c Dichotomous: 1=White, 2=Non-white
d Dichotomous: 0=Male, 1=Female
e Dichotomous: 0=Not sleep-related, 1=sleep-related

Sleep-related cause cohort. *All responses*. Descriptive analyses relied on the entire dataset formed for the sleep-related cause cohort, regardless of missing data. The sample used for this dataset was comprised of 384 cases (Table 3.2).

Table 3.2
Descriptive Statistics for the Sleep-Related Cause Infant Cohort, All Responses (n=384)

Variables	Type	*n*	Min	Max	Mean	StDv
Infant race[a]	IV	379	1	6	1.33	0.98
Infant age (months)	IV	384	1	5	1.43	1.31
Infant sex[b]	IV	382	1	2	1.41	0.49
Days alive	IV	384	0	359	102.11	72.1
Maternal age at infant death	IV	347	15	41	24	5.1
Maternal education level[c]	IV	168	1	4	1.57	0.91
Maternal employment status[d]	IV	322	1	4	2.04	0.67

(Continued) Descriptive Statistics for the Sleep-Related Cause Infant Cohort, All Responses

Number of other children living with decedent	IV	292	0	11	1.45	1.41
Was death attributed to sleeping environment[e]	IV	357	1	2	1.02	0.15
Incident sleep place[f]	IV	312	1	8	3.27	1.93
Position put to sleep[g]	IV	295	1	3	1.56	0.68
Position child found[h]	IV	292	1	3	1.8	0.65
Usual sleep place[i]	IV	223	1	8	2.39	1.6
Child sleeping on same surface with person or animal[j]	IV	257	1	2	1.38	0.49

Note. a Nominal: 1=White, 2=Black, 3=Hawaiian/Pacific Islander, 4= American Indian/Alaskan Native, 5=Asian, 6=Multi-Race, 9=Unknown
b Dichotomous: 1=Male, 2=Female
c Ordinal: 1 = Less than high school, 2 = High school, 3 = College, 4 = Post graduate
d Nominal: 0= Unemployed/stay-at-home, 1=Employed
e Ordinal: 1=Yes, 2=No
f Ordinal: 1=Crib, 2=Bassinette, 3=Adult bed, 4=Waterbed, 5=Playpen, other structure, not portable crib, 6=Couch, 7=Chair, 8=Floor, 9=Carseat
g Ordinal: 1=On back, 2=On stomach, 3=On side
h Ordinal: 1=On back, 2=On stomach, 3=On side
i Ordinal: 1=Crib, 2=Bassinette, 3=Adult bed, 4=Waterbed, 5=Playpen, other structure, not portable crib, 6=Couch, 7=Chair, 8=Floor, 9=Carseat
j Dichotomous: 1=Yes, 2=No

Only known responses. For the sleep-related cause cohort, all attributes of sleep environment—incident sleep place, position put to sleep, position child found, usual sleep place, and child sleeping on same surface with person or animal were reduced to dichotomous variables (Table 3.3). All were previously nominal. Incident and usual sleep place were changed to "crib" or "not-crib", position put to sleep and found became "back" or "side or stomach", and child sleeping on same surface was made "bed sharing" or "not bed sharing". As previously stated, the resulting sample used for inferential analyses was 151.

Table 3.3
Descriptive Statistics for the Sleep-Related Cause Infant Cohort, Without Missing/Unknown Responses (n=151)

Variables	Type	*n*	Min	Max	Mean	StDv
Infant race[a]	DV	151	0	1	0.74	0.44
Incident sleep place[b]	IV	151	1	2	1.73	0.45
Position put to sleep[c]	IV	151	1	2	1.36	0.48
Position child found[d]	IV	151	1	2	1.64	0.48
Usual sleep place[e]	IV	151	1	2	1.61	0.49
Child sleeping on same surface with person or animal[f]	IV	151	1	2	1.44	0.5

Note. a Dichotomous: 1=White, 2=Non-white
b Ordinal: 1=Crib, 2=Not crib
c Ordinal: 1=On back, 2=On side or stomach
d Ordinal: 1=On back, 2= On side or stomach
e Ordinal: 1=Crib, 2=Not crib
f Dichotomous: 1=Yes, 2=No

All cause infant cohort analyses

The next stage of the analysis involved the all cause infant cohort to determine intercorrelations between infant and maternal factors and whether infant or maternal characteristics could predict whether an infant died of a sleep-related cause or non-sleep related cause. Pearson correlation coefficients were calculated to examine intercorrelations of three maternal factors—maternal age at time of infant death, maternal education and employment, and four infant factors—days alive, race, number of children living with decedent, and infant sex. These were the independent variables (Table 3.1). The dependent variable was cause of death, either sleep-related or not sleep-related. Logistic regression was then run to assess the predictive ability of the same infant and maternal variables when considering sleep or not sleep-related death outcomes.

Sleep-related cause cohort analyses

Incidence trends. Trend analyses were performed using sleep-associated mortality rates calculated from the number of sleep-associated deaths reported in the CDR system for the number of live births, annually. The analysis was used to assess the trajectory of sleep-related mortality for the study period and the anticipated linear trend for future years. Next, rates for subcategories of sleep-related cause were calculated and included SIDS, asphyxia, and undetermined or unknown to uncover how each subcategory was affecting the overall trend for sleep-related deaths.

Infant mortality characterization. Descriptive frequencies for infant and maternal demographic factors were calculated to form a profile of infants who have died from SIDS and related causes from 2004-2012. Variables included multiple descriptors for the infant, the infant's mother, and the infant's environment at time of death (Table 3.2).

Infant mortality inferential statistics. Two-way contingency tables were used to evaluate whether statistically significant differences exist between infant positioning and sleep environment by race group.

Hospital safe sleep characterization and survey analyses

A list of all Iowa hospitals was obtained from the Iowa Hospital Association (Iowa Hospital Association, n.d.). This list was merged with one provided by IDPH that identified only hospitals with maternity units (Iowa Department of Public Health, 2013). Finally, the number of births reported in 2010 was appended to the hospital file. The resulting workbook provided hospital type, location, number of births (in 2010).

Descriptive analyses. Frequency analyses were run to determine the percentage of hospital types present among respondents, percentage of hospitals with policies, components of the policies, safe sleep education topics, clinical staff training on safe sleep, and familiarity with

state and national prevention programs. When appropriate, results were viewed according to hospital type (critical access, rural, rural referral, or urban).

Inferential statistics. Inferential statistics were considered for this survey where the contents of policies updated before 2011 and after would be assessed for appropriate components, but it was found after the survey was complete that nearly all hospital safe sleep policies were updated after 2011.

Retracted analyses

Matching of birth location for infants in the CDR system to birthing hospitals was considered. The approach was to determine if the presence of safe sleep policies, components of parental education programs, or clinical training requirements predicted whether an infant would die of a sleep-related cause. This proposal was deemed too biased with the potential for identifying false statistical relationships, as the number of deaths per site would have been small and a multitude of confounders would be present.

Data storage and retention

Only the primary investigator had access to the study data. All data were kept in a single password-protected laptop in a separate cloud storage site also requiring a password. All final publication of data, including the dissertation, was stripped of identifiers.

Design issues

CDR system data- all cause and sleep-related cause cohorts

The descriptive segment of this project relies completely on data drawn from the CDR system. IOSME staff manages the data collected for reporting and uniformity is not ensured for every case. Reports and supporting circumstantial evidence are not always available for child

mortality cases. Therefore, missing or unknown responses within this dataset may affect analytic outcomes. IOSME data collection procedures improve the potential reliability of data reported.

Non-sleep-related infant deaths serve as a comparison population to sleep-related death cases, but are not actual controls. The non-sleep-related death cases do not have data on sleep the infant's environment, so only maternal and infant characteristics could be considered for use in inferential statistics. Additionally, there was no outcome or dependent variable to use in anticipatory analyses such as correlations or regressions. However, Chi-square analysis allowed identification of critical disparities in sleep environment practices.

Hospital survey

A lack of baseline data on safe infant sleep practice in Iowa hospitals may have contributed to reliability issues in this study. Results were entirely self-reported, though hospital policies were obtained for informal comparison of responses to policies. OB coordinators were asked to infer why clinical staff would use a sleep position other than supine. This resulted in very subjective responses for that question. Overall, a depiction of the current state of hospital policy, practice, and training was valuable.

Limitations and delimitations

Infant mortality analysis

The CDR system from which infant mortality will be drawn for this study has standardized data collection and reporting protocols ensuring reliability of data. Coding, file cleaning, and variable aggregations were taken from supporting files provided by the CDR system analysts to ensure consistency in the use of data for this study in comparison to other studies using the same data source. Results from this study should be easily replicable using the same data source and methods.

This aspect of the study is a retrospective case control study, with inferences drawn using a non-standard control group. The limitation in using a comparison population largely comprised of infants who died from congenital anomalies is that death usually occurs on day zero or one of life. This affects days lived correlations and was noted in the methods and results chapters. This study was also limited by the inability to provide a comparison group for reviewing factors within the infant's sleep environment. However, frequencies and comparison inferences are extremely helpful in identifying trends, at-risk subpopulations, and disparities in this population.

Hospital survey

The survey component of the study was limited by its cross-sectional format. Inferential statistics may demonstrate associations between variables, but not all confounding factors may be known. The study was being conducted at a single point in time, whereas a longitudinal, or even retrospective examination of hospital practice and policy would have revealed whether shifts occur when patient education is in alignment with AAP recommendations.

With regard to internal validity, or the extent to which the study results are true for the study population, two issues may arise, 1) systematic error is possible given the lack of selection criteria of hospitals for the quantitative survey, or 2) internal validity may be compromised by the subjectivity in survey responses.

External validity or generalizability is limited by attributes of the population of Iowa and hospital variance. All results from this study may be generalized to states with populations of similar size and racial composition as Iowa. However, results may not be generalizable to hospitals in large metropolitan areas or in states with few rural or critical access hospitals. Findings from the hospital survey may be applicable to any birthing unit as policies and practices

for safe infant sleep are primarily influenced by national recommendations stemming from the AAP.

Summary

Sound methodology and methods are imperative for quantitative research. This chapter lays out the design for this project. While there were several components, the results of the CDR system data provided a baseline for Iowa sleep-related infant mortality events. These data are useful to many groups, especially birthing hospitals. The hospital policy and practice analysis supplies a picture of the current state of frontline efforts to prevent sleep-related deaths. Identifying weaknesses in hospital practice and combining those with a detailed infant, maternal, and environmental characterization will optimize revisions to present-day practice. Chapter 4 outlines the results of the study.

CHAPTER IV

RESULTS

The analysis for this study is parsed into two sections, 1) results from an examination of the Child Death Reporting (CDR) system of Iowa cases, and 2) survey conducted with Iowa birthing hospitals. Infant mortality, maternal, and sleep environment data provide an in-depth picture of sleep-related mortality events in Iowa. Dominant attributes of these cases are likely to vary by state and an analysis of the Iowa CDR has never been conducted since case entry began in 2004. The results of this analysis are likely to impact health care providers, advocates of SIDS prevention, public health, and even legislators.

Hospital survey data were obtained to assess the current state of safe infant sleep education and practice in Iowa birthing hospitals. While hospital size and capacity vary, the presence of safe sleep policies and awareness of changing national guidelines help demonstrate the need for state-level action. The last known survey of safe infant sleep practice promotion in hospitals was conducted in Iowa in 1997 and resulted in valuable insights to nursing practice (Hein & Pettit, 2001). The present survey was developed with the preceding survey in mind, but with modifications since this effort was not directed at individual nursing staff.

Sleep-Related Cause Infant Cohort

Infant and maternal characteristics from the all-cause infant mortality cohort were examined together to identify potential correlations between factors, and through regression uncover characteristics predictive of sleep-related infant deaths. Sleep environment characteristics were reviewed for all cases of sleep-related infant death (n=384). Frequency descriptions followed by contingency table analyses were done to determine the influences of

variables on one another, as well as agreement among variables indicating usual practice compared to incident practice.

Trends in sleep-related mortality

Annual mortality rates for sleep-associated deaths were calculated per 1,000 live births. The rate of sleep-related mortality started in 2004 at a low of 0.83 deaths for every 1,000 live births. Since 2004, the rate has gradually increased to 1.09 in 2012, reaching a high of 1.37 in 2008 (Figure 4.1). The trend line indicates this phenomenon will continue to increase in successive years.

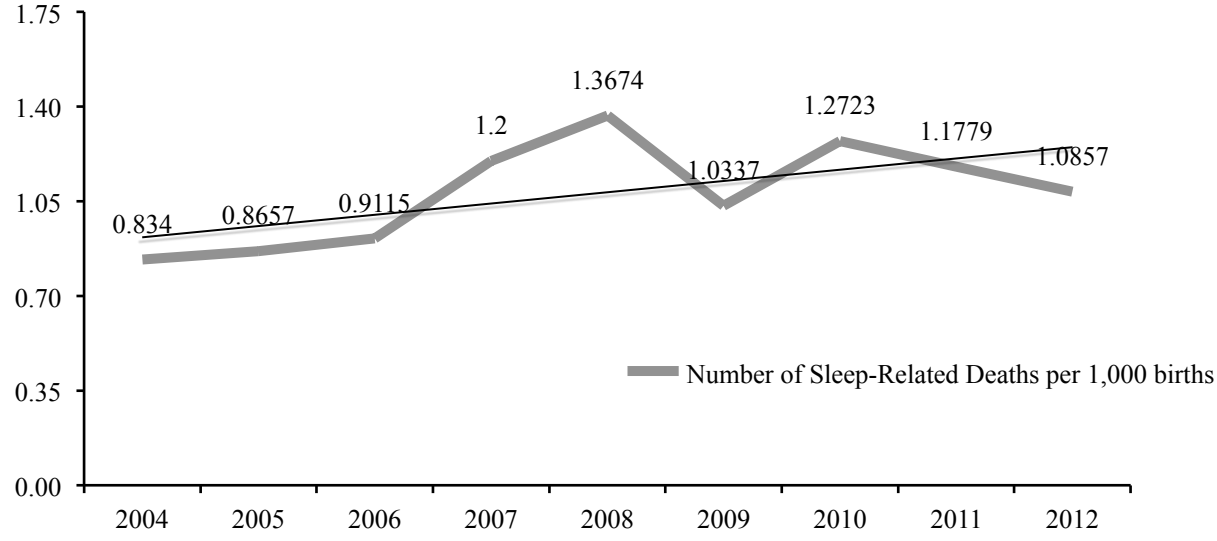
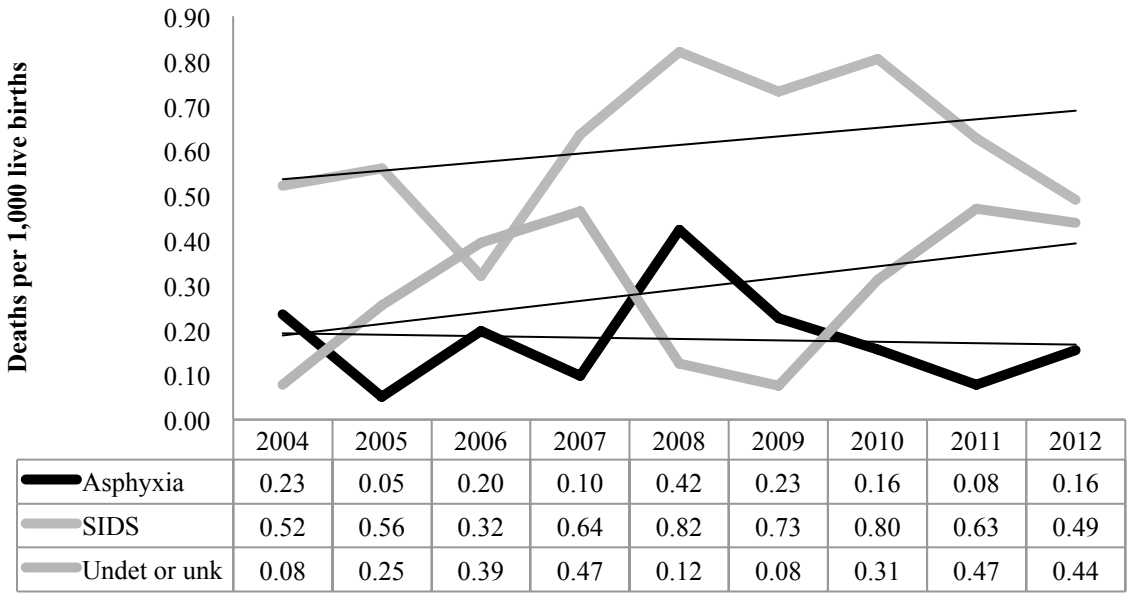


Figure 4.1 Rate of Sleep-Related Deaths Per 1,000 Live Births and Linear Trend, 2004-2012

For the sake of comparison to national rates, sleep-related mortality rates were divided into subgroups of SIDS, asphyxia, and undetermined and unknown. SIDS rates were well below the national average of 0.67 deaths per 1,000 live births in 2004, but increased overall primarily due to three consecutive years of high rates in 2008-2010 (Barfield et al., 2013). Rates in 2011 and 2012 were declining; however, the trend line indicates likely continued overall increase.

Mortality rates due to undetermined or unknown cause have a gradually increasing trend line since 2004, but have fluctuated greatly over that time. Trend line trajectory indicates the increase will continue.

Rates due to asphyxia were slightly decreasing over time. This is in contrast to the national trend showing an increase in mortality in the same time period (Barfield et al., 2013).



	2004	2005	2006	2007	2008	2009	2010	2011	2012
Asphyxia	0.23	0.05	0.20	0.10	0.42	0.23	0.16	0.08	0.16
SIDS	0.52	0.56	0.32	0.64	0.82	0.73	0.80	0.63	0.49
Undet or unk	0.08	0.25	0.39	0.47	0.12	0.08	0.31	0.47	0.44

Figure 4.2 Rate of Sleep-Related Deaths Per 1,000 Births by Subcategory of Asphyxia, SIDS, and Undetermined or Unknown Cause

It was apparent that SIDS and asphyxia deaths likely constituted the case increase seen in overall sleep-related mortality rates from 2004-2012 (Figure 4.2).

Sleep environment characteristics

Frequency distribution. Frequency assessments were done on factors characterizing sleep environment and infants who died of sleep-related cause (Table 4.1). SIDS accounted for more than half of sleep-related deaths. Nearly 60% were male and 80% were white. The highest frequency of deaths occurred in January at 10.9%.

Data on sleep environment were captured at the time of the incident of death and compared to the factors that were typical for the infant's sleep environment. Most sleep-related deaths occurred in a sleep place that was not a crib, though caregivers reported 50% of infants usually did not sleep in a crib (Table 4.2). Reportedly 43% of infants were placed on their backs to sleep prior to the incident, but only 25% were found in that position. Lastly, more than 40% of infants were bed sharing at time of death with at least one other child or adult.

Table 4.1

Frequency Distribution of Sleep-Related Infant and Environmental Factors (n=384)

Factor	**Response**	**Frequency**	**Percent**
Cause of death	Asphyxia	64	16.7
	SIDS	217	56.5
	Undet or unk	103	26.8
Infant sex	Male	225	58.6
	Female	157	40.9
	Unknown	2	0.5
Infant race	White	313	81.5
	African American	49	12.8
	American Indian/ Native Alaskan	3	0.8
	Asian	2	0.5
	Multi-racial	12	3.1
	Missing	5	1.3
Date of death - Month	Jan	42	10.9
	Feb	28	7.3
	March	23	6
	April	35	9.1
	May	35	9.1
	June	34	8.9

(continued) Frequency Distribution of Sleep-Related Infant and Environmental Factors (n=384)

Factor	Response	Frequency	Percent
	July	36	9.4
	Aug	34	8.9
	Sept	31	8.1
	Oct	34	8.9
	Nov	19	4.9
	Dec	33	8.6
Incident sleep place	Crib	75	19.5
	Not a crib	303	78.9
	Other	6	1.6
Usual sleep place	Crib	92	24
	Not a crib	192	50
	Other	100	26
Position child was placed to sleep	Back	166	43.2
	Side or stomach	129	33.6
	Unknown	89	23.2
Position child was found	Back	97	25.3
	Side or stomach	195	50.8
	Unknown	92	24
Child sleeping on the same surface as a child or adult	Yes	160	41.7
	No	97	25.3
	Unknown	127	33.1

Skew and kurtosis. Skewness values ranging from -1 to 1 are within the normal range needed for inferential statistics. However, even with shifts marginally above the accepted values for these data, the analyses should not be affected as Chi-square does not require assumptions

about the distribution of the population (Morgan et al., 2013). The skew and kurtosis for the variables used in sleep environment inferential tests were all within normal range.

The normal curves for all variables were slightly platykurtic. However, this is not believed to affect any outcomes as kurtosis of a frequency distribution has little effect on statistical analyses (Morgan et al., 2013).

Table 4.2

Normative Assumptions for the Sleep-Related Infant Cohort, Without Missing/Unknown Responses (n=151)

	n	**Min**	**Max**	**Mean**	**StDv**	**Skew**	**Kurtosis**
Infant race	151	0	1	0.7483	0.43541	-1.156	-0.673
Incident sleep place	151	1	2	1.7285	0.44623	-1.038	-0.936
Usual sleep place	151	1	2	1.6093	0.48954	-0.452	-1.82
Position child found	151	1	2	1.6358	0.48282	-0.57	-1.698
Child sleeping on same surface with person or animal	151	1	2	1.4437	0.49847	0.229	-1.974
Position put to sleep	151	1	2	1.3642	0.48282	0.57	-1.698

Two-way contingency tables. A two-way contingency table was run to evaluate if there was a difference in whether non-white or white infants were bed sharing at the time of death (Table 4.3). The two variables were infant race with two levels (non-white and white) and sharing a sleep surface with two levels (sharing and not sharing). Results indicate there is a statistically significant difference in whether bed sharing occurred by race, Pearson $\chi 2(1, n=151)=6.7$, $p=0.01$, Cramer's $V=0.211$. The proportion of infants who were not bed sharing and were white was 0.263.

Table 4.3

Two-Way Contingency Table of Infant Race and Bed Sharing (n=151)

		Bed sharing*		
		Yes	No	Total
Non-white	Count	28	10	38
	Expected Count	21.1	16.9	38
	% within infant race	73.70%	26.30%	100.00%
White	Count	56	57	113
	Expected Count	62.9	50.1	113
	% within infant race	49.60%	50.40%	100.00%
Total	Count	84	67	151
	Expected Count	84	67	151
	% within infant race	55.60%	44.40%	100.00%

Note. *Same variable as "same sleep surface as child or adult"

To further explore sleep environment factors related to race, a two-way contingency table was run examining the difference in whether non-white and white infants were usually placed in a crib (Table 4.4). The variables were again infant race and usual sleep place with two levels (crib and not a crib). Results indicate there is a statistically significant difference in where an infant is usually sleeping by race, Pearson $\chi 2(2, n=151)=5.05$, $p=0.025$, Cramer's $V=0.183$. The proportion of infants who were sleeping in a crib and were non-white was 0.237.

Table 4.4

Two-Way Contingency Table of Infant Race and Infant's Usual Sleep Place (n=151)

		Usual sleep place		
		Crib	Not a crib	Total
Non-white	Count	9	29	38
	Expected Count	14.8	23.2	38
	% within Infant race	23.705	76.30%	100.00%
White	Count	50	64	113
	Expected Count	44.2	68.8	113
	% within Infant race	44.20%	55.80%	100.00%
Total	Count	59	92	151
	Expected Count	59	92	151
	% within Infant race	39.10%	60.90%	100.00%

A final two-way contingency table was created to determine if a difference between race groups held when infant positioning was considered (Table 4.5). The variables were infant race and sleep position placed with two levels (on back or side/stomach). Results indicate there is not a statistically significant difference in sleep positioning based on race, Pearson $\chi 2(1, n=151)=0.204$, $p=0.652$, Cramer's $V=0.037$. The proportion of infants who were placed to sleep on their side or stomach based on race was 0.395.

Table 4.5

Two-Way Contingency Table of Infant Race and Position Infant Placed to Sleep (n=151)

		Position put to sleep		
		Back	Side or stomach	Total
Non-white	Count	23	15	38
	Expected Count	24.2	13.8	38
	% within Infant race	60.50%	39.50%	100.00%
White	Count	73	40	113
	Expected Count	71.8	41.2	113
	% within Infant race	64.60%	35.40%	100.00%
Total	Count	96	55	151
	Expected Count	96	55	151
	% within INFRrace5	63.60%	36.40%	100.00%

Additional two-way contingency tables were run on maternal and infant factors with no results identified outside of those found in the correlation matrix. Correlations between maternal factors and sleep environment were investigated for interactions. There were no statistically significant correlations identified between maternal and sleep environment, though analyses may have been limited by sample size. Inferential, predictive statistics could not be performed on sleep environment and cause of death because sleep environment factors were not captured for infants who died of non-sleep related causes.

All cause infant cohort

Infant and maternal characteristics

Assumptions of normality. *Skewness*. Several variables are slightly skewed to the right and include maternal age, education level, cause of death, and number of children living with decedent (Table 4.6). The skewed distribution of maternal age is expected, as the US average maternal age is 25.4 years (US Department of Health and Human Services, 2012). Spikes in frequency occurring at ages 20 and 25 identify two age groups that could be targeted for more intensive prevention efforts; however, overall infant deaths are most likely to fall within the maternal age range of 18 to 29 years. Education frequencies indicate mothers most commonly finished high school, resulting in a minor shift to the right. The cause of death-normalized curve has a minor shift to the right as more cases were categorized as non-sleep related than sleep-related. More significant shifts were apparent for number of days lived, due to heavy concentration of deaths on day zero of life and race, due to the majority of infants falling into the white race category. Skewness values ranging from -1 to 1 are typically within the normal range needed for inferential statistics and all but two are within or close to this range (Morgan et al., 2013).

Kurtosis. The normal curves are leptokurtic for maternal age, number of days lived, and race (Table 10). The remaining variables of maternal education, employment, sex, and cause of death are platykurtic. Kurtosis of a frequency distribution has little effect on statistical analyses (Morgan et al., 2013).

Table 4.6

Normative Assumptions for the All-Cause Infant Cohort (n=293)

Variable	N	Mean	SD	Skewness	Kurtosis	Min	Max
Maternal age at infant death	293	25.8	5.95	0.7	0.14	15	45
Maternal education level	293	2.18	0.72	0.16	-0.22	1	4
Maternal employment status	293	0.624	0.49	-0.517	-1.74	0	1
Number of days child lived	293	80.12	86.6	1.25	1.27	0	359
Infant race	293	1.2	0.4	1.5	0.24	1	2
Sex	293	1.4	0.49	0.4	-1.85	1	2
Cause of death	293	0.48	0.5	0.08	-2.01	0	1
Number of children living with decedent	293	1.24	1.36	1.533	3.211	0	8

Frequency distribution. The average maternal age at infant death was 25.8 years preliminarily indicating age may not be a factor in Iowa sleep-related deaths (Table 4.7). This is close to the national average maternal age previously mentioned of 25.4 years. Infants who died of SIDS and related cause live an average of 80 days or approximately 2.5 months. The average number of children living with the infant at time of death is 1.24. Infants are more often male than female.

More than half of mothers graduated high school, but did not continue to complete college. The majority of mothers were employed, though a significant percentage of 37.5 stayed at home, were unemployed, or were on disability. Infants were much more likely to be white than any other race group, though this is typical of the racial distribution of Iowa.

Table 4.7

Descriptive Frequencies of Maternal and Infant Factors (n=293)

Variable	Value	Freq	Percent
Maternal education level	Less than HS	45	15.4
	HS	157	53.6
	College	83	28.3
	Post grad	8	2.7
Maternal employment status	Unemployed, stay at home or disabled	110	37.5
	Employed	183	62.5
Race	White	234	79.9
	Non-white	59	20.1
Sex	Male	175	59.7
	Female	118	40.3

Correlations. Pearson correlation coefficients were computed between each of the variables (maternal age at infant death, maternal education level, maternal employment status, number of days child lived, infant race, infant sex, cause of death, and number of children living with the decedent), resulting in 28 correlation coefficients represented in Table 4.8. To avoid the risk of Type I error in determining statistical significance when computing multiple correlations, the Bonferonni approach was used to determine the new level of statistical significance. The Bonferronni approach involves dividing an alpha level (0.05) by the number of correlations (28), which results in a new alpha level (0.0018). In this study, correlations required a *p* value of 0.05 or lower to be considered significant. Using 0.0018 as the revised and conservative significance level, 12 of 28 correlations were deemed significant.

Table 4.8

Intercorrelations, Means, Standard Deviations for Eight Infant Mortality Variables (n=293)

		1	2	3	4	5	6	7	8
1	Cause of death	--							
2	Maternal employment status	.013	--						
3	Maternal age at infant death	-.183**	.165**	--					
4	Maternal education level	-.067	.298**	.405**	--				
5	Number of days child lived	.400**	.111	.015	.052	--			
6	Number of children living with decedent	.115*	-.236**	.258**	-.074	-.050	--		
7	Race	.044	-.138*	-.186**	-.165**	.132*	.162**	--	
8	Sex	.045	.004	-.043	-.017	-.026	.048	.004	--

Note. *p<0.05, **p<0.01

Pearson correlation coefficients were computed to examine the intercorrelations of 28 variables. Morgan, et al (2013) cites low correlations as those less than 0.2, moderate as 0.2-0.4, and high as >0.4. Table 4.8 shows 12 pairs of variables were significantly correlated with five low correlations, four moderate, and one high correlation.

Low correlations. A slightly negative correlation existed between cause of death and maternal age (r=-0.183, p<0.0018) indicating mothers were likely to be younger as deaths were increasingly sleep-related. Cause of death was positively associated with number of children living with the decedent (r=0.115, p<0.0018). This finding demonstrated cause of death was more likely to be sleep-related if the child lived with a higher number of children at time of death. Maternal employment status was slightly positively correlated with maternal age at infant death (r=0.165, p<0.0018) showing as mothers were increasingly employed they were also older. There was a low, negative correlation between infant race and maternal age at infant death (r=-

0.186, $p<0.0018$) denoting infant race was likely to be white as mothers were younger. A low, inverse correlation was identified between infant race and maternal education level ($r=-0.165$, $p<0.0018$). When infant race was white, maternal education was categorically lower.

Moderate correlations. Four moderate correlations resulted from this analysis. Maternal employment status was negatively correlated with number of children living with the infant ($r=-0.236$, $p<0.0018$), showing that mothers who were employed had fewer children. Number of children living with the infant was moderately and positively associated with maternal age ($r=0.258$, $p<0.0018$) indicating the number of children living with the infant increased with higher maternal age. Maternal education was associated with maternal employment ($r=0.298$, $p<0.0018$) in that as maternal education was higher mothers were increasingly employed. Cause of death was positively associated with number of days a child lived ($r=0.4$, $p<0.0018$) demonstrating that as cause of death was sleep-related the number of days a child lived was higher.

High correlations. Maternal age at infant death had a moderately positive association with maternal educational attainment ($r=0.405$, $p<0.0018$) indicating that as maternal age increased, maternal education was higher.

Regression. A logistic regression analysis was performed to determine whether maternal employment, age, education level, number of children living with decedent, infant race, sex, and days alive were statistically significant predictors for whether or not infants would die of sleep-related causes. Results of the analysis revealed the combination of independent variables significantly predicted whether or not an infant died from a sleep-related cause, $\chi2=82.097$, $df=7$, $N=293$, $p<0.001$. Table 4.9 provides the degrees of freedom (*df*), Wald $\chi2$, and unstandardized regression coefficient (SE β), and odds ratio. The table reveals three significant results

suggesting that the odds of an infant dying of a sleep-related cause decrease as maternal age increases, but increased as the number of children living with the infant increases. A significant, but null effect between sleep-related mortality and days alive was noted. The model correctly predicted 81.6% (91 out of 124) of those infants that did not die of sleep-related causes and 70.2% (99 out of 141) of infants who died of sleep-related causes.

Table 4.9

Logistic Regression Predicting Whether Infantile Cause of Death is Sleep-Related (n=293)

Variables	**df**	**Waldxχ2**	**β**	**SE β**	**Odds Ratio**
Constant	1	3.715	1.851	0.96	6.366
Maternal employment status	1	0.889	0.283	0.3	1.327
Maternal age at infant death	1	18.07	-0.126	0.03	0.881**
Number of children living with decedent	1	13.378	0.449	0.123	1.567**
Maternal education level	1	0.009	0.02	0.218	1.021
Infant race	1	2.599	-0.590	0.366	0.554
Infant sex	1	0.386	0.172	0.277	1.188
Days alive (infant)	1	42.937	0.013	0.002	1.013**

Note: *Nagelkerke* R^2=0.326; Cox & Snell R^2=0.244
*p<0.01

Safe sleep education survey

The nature of the survey was descriptive and intended to identify the presence of a safe sleep education policy and its core components. Practice and training of staff were also queried. Results were assessed by examining each individual question and also by evaluating at the response level.

Respondent frequencies. The average response count per question was 42, with 34 of 70 unique hospitals represented in the survey. Every category of hospital was amply

represented, though the proportion of respondents from critical access hospitals was larger than the proportion of annual births performed at that facility type (Table 4.10).

Table 4.10

Respondent Frequencies from the Hospital Safe Sleep Education Survey (n=42)

Hospital category	% of annual births	Respondent count (unique)	%	Response count (sum)	%
Critical access	13.50	18	52.9	20	58.8
Rural	5.20	2	5.9	2	5.9
Rural referral	10	3	8.8	3	8.8
Urban	71.40	11	32.4	17	50.0

Descriptive frequencies. All respondents were obstetric unit supervisors, directors, managers, or listed their position as "nurse". The majority were healthcare clinicians, with half having worked in their current position for more than 11 years and more than 20 years in their current profession. (Table 4.11).

Table 4.11

Demographic Characteristics of OB Coordinators from the Hospital Safe Sleep Education Survey (n=42)

Question	Answer	Response	%
3. Select the professional category that aligns with your current position.			
	Healthcare clinician (e.g., physician, nurse)	37	90
	Education (e.g., teacher, school administrator)	1	2
	Social services (e.g., social work)	0	0
	Public health	0	0
	Other	0	0
	Other	3	7

(Continued) Demographic Characteristics of OB Coordinators from the Hospital Safe Sleep Education

Question	Answer	Response	%
4. How long have you worked in your current position?			
	Less than 1 year	1	2
	1-4 years	7	17
	5-10 years	13	31
	11+ years	21	50
5. Select the number of years you have worked in current profession.			
	0-4	0	0
	5 to 10	3	7
	10 to 20	13	31
	20+	26	62

Policy presence and content. Almost two-thirds of hospitals reported having a policy directly addressing safe infant sleep with parents of newborns, though 21% do not have a policy (Table 4.12). Of those without a policy, five were critical access, two rural referral and one each of rural and urban. For those responding positively to having a safe sleep policy, additional questions about policy content were asked. Policies generally contained all topics essential to preventing and protecting against sleep-related mortality. More than 90% addressed sleep environment, position, and risk of SIDS. Only one policy allowed use of side sleep, the rest emphasized back only sleep.

Surprisingly, all but three policies had been updated after the American Academy of Pediatrics (AAP) revised safe sleep recommendations in 2011, though 75% of respondents indicated their policy was updated as a result of the new AAP guidelines.

Table 4.12

Frequency Responses on Safe Sleep or SIDS Policies from the Hospital Safe Sleep Education Survey

Question	Answer	Response	%
9. Does your hospital have a policy addressing safe sleep or SIDS education to parents of newborns? (n=42)	Yes	31	74
	No	9	21
	Not sure	2	5
10. What components of safe sleep education are required according to hospital policy (select all that apply)? (n=30)	Sleep environment	28	93
	Sleep position	28	93
	SIDS	27	90
	Sleep location	27	90
	Bed sharing	26	87
	Co-sleeping	24	80
	Smoke exposure	24	80
	Overheating/room temperature	23	77
	Safe sleep education is not required by hospital policy	7	23
	Pacifier	1	3
11. Does your hospital's safe sleep or SIDS prevention policy require clinical staff place infants on their back to sleep? (n=30)	Yes, only back sleep is allowed	29	97
	Yes, but side sleep is occasionally allowed	1	3
	No	0	0
12. In what year was your hospital policy last updated? (n=28)	2008	1	4
	2009	0	0
	2010	2	7
	2011	0	0
	2012	3	11
	2013	17	61
	2014	5	18
13. Was your hospital safe sleep or SIDS prevention policy updated following the American Academy of Pediatrics revised recommendations in 2011 for back only sleep? (n=28)	Yes	21	75
	No	4	14
	Not sure	3	11

OB coordinators universally reported covering SIDS education with parents of newborns. Verification of education delivery varied. Most hospitals report consistently placing infants on their backs with nothing in the crib and provide educational take-home information (Table 4.13). A documentation requirement was reported by 63% of facilities. A little more than one third require families to watch a safe sleep education film.

Table 4.13

Frequency Responses on Safe Sleep Practice from the Hospital Safe Sleep Education Survey (n=42)

Question	Answer	Response	%
14. What topics are covered in safe infant sleep education delivered to parents of newborns (check all that apply)?	SIDS	38	100
	Sleep location	37	97
	Bed sharing	37	97
	Sleep position	37	97
	Sleep environment	36	95
	Co-sleeping	34	89
	Overheating	34	89
	Smoke exposure	32	84
	Other	6	16
15. In what ways do you ensure that safe sleep education is delivered by clinical staff to all parents of newborns at your hospital (check all that apply)?	Have the nursing staff model the appropriate behavior during the infant's hospital stay, by always placing infants on their back and having nothing in the crib	37	97
	Provide a handout/brochure in the discharge packet of education material provided to families	34	89
	Nursing staff are required to provide safe sleep or SIDS education to all parents per hospital policy	31	82
	Nursing staff are required to chart safe sleep or SIDS education administration in the mother and/or infant's medical record	24	63
	Encourage families to watch safe sleep education included on our hospitals closed circuit TV channel prior to discharge	14	37
	Other	5	13
	Nursing staff are encouraged, but not required to administer safe sleep or SIDS education to parents	4	11

Question 16, requesting a response to why clinical staff might place an infant in a position other than supine, provided evidence that side and stomach sleep may be occasionally used by nursing staff. An average of half of hospitals suggested side or stomach sleep were not used by clinical staff (Table 4.14). Citations of prematurity and medical limitations to back sleep were provided by 8% and 43% of respondents, respectively. Fear of aspiration was reportedly a concern in about 20% of hospitals. Only two hospitals reported staff might position infants in a non-supine manner because of the belief the infant would sleep better.

Table 4.14

Frequency Responses for Clinical Staff Positioning from the Hospital Safe Sleep Education Survey (n=42)

Question	Answer	Response	%
16. For which of the following reasons do you believe would clinical staff place infants on their SIDE or other non-back position (check all that apply)?	Side position is not used by clinical staff	20	54
	Stomach position is not used by clinical staff	17	46
	Infant medical condition restricting or preventing use of back sleep	16	43
	To prevent aspiration	7	19
	Prematurity	3	8
	Other	3	8
	Infant sleeps better	2	5
	Parent preference or concern	0	0

Evaluation of hospital-based training for clinical staff was an important aspect of this survey. SIDS or safe sleep training is required by less than half of facilities, though a few were not sure of a requirement (Table 4.15). Most often training is provided through "Train the Trainer" programs, and in one-quarter of facilities is offered by the facility. Coordinators did not frequently use online training for either continuing medical education (CME) or non-CME for

sleep education training. Lastly, one quarter of hospitals administered standardized sleep training and the majority were unsure or did not offer standardized training.

Table 4.15

Frequency Responses on Clinical Training from the Hospital Safe Sleep Education Survey (n=42)

Question	Answer	Response	%
17. Are your clinical staff required to complete safe sleep or SIDS training?	Yes	18	47
	No	18	47
	Not sure	2	5
18. In what ways does your hospital encourage clinical staff to complete safe sleep or SIDS education (select all that apply)?	Train the trainer programs	12	41
	Other	10	34
	Continuing medical education (CME) provided by the hospital	7	24
	Continuing medical education (CME) done outside the hospital	4	14
	Online course, non CME	4	14
	Online course, CME earned	2	7
19. Does your hospital administer a standardized safe sleep or SIDS education program to clinical staff?	Yes (list the name of the program below)	9	24
	No	26	68
	Not sure	3	8

OB coordinators were asked to rate the strength of their SIDS or safe sleep prevention programs. The average value was 7.66 indicating room for improvement, but an overall solid score (Table 4.16). The minimum value reported was three while the maximum reported value was 10.

Table 4.16

Rating of Safe Sleep or SIDS Program Strength from the Hospital Safe Sleep Education Survey (n=42)

Question	Answer	Min Value	Max Value	Average Value
22. Rate the strength of your safe sleep or SIDS program on the following scale:	0=Weak, 10=Strong	3	10	7.66

Respondents were queried about their familiarity with various national and state programs working to prevent SIDS events or instances of unsafe sleep resulting in death. The Iowa SIDS Foundation was well known among hospitals (Table 4.17). Several coordinators noted the Foundation in the comments sections of preceding questions. First Candle, a SIDS advocacy organization, was known to slightly less than half; only one quarter recognized the national SIDS curriculum for nurses, and fewer the Cribs for Kids program.

Table 4.17

Frequency Responses for Familiarity with State and National Safe Sleep or SIDS Programs from the Hospital Safe Sleep Education Survey (n=42)

Question	Answer	Response	%
23. What local, state or national safe sleep or SIDS programs are you familiar with (check all that apply)?	Iowa SIDS Foundation	37	97
	First Candle	16	42
	Continuing Education Program on Sudden Infant Death Syndrome (SIDS) Risk Reduction: Curriculum for Nurses (Eunice Kennedy Shriver National Institute of Child Health and Human Development)	9	24
	Cribs for Kids	5	13
	Other (list)	4	11

Summary answers to research questions

Research question one

1) Are there disparities among infants who die of sleep-related causes, what are the demographic and circumstantial characteristics of those fatalities, and what infant, maternal and environmental factors predict SIDS and related mortality incidence?

The first research question posed, in part, was whether disparities were present among infants who die of sleep-related causes. From the frequency analyses it was apparent a high proportion of black infants had died from sleep-related causes, 12.8%, whereas black infant comprise only 5.3% of births in Iowa (Iowa Department of Public Health, Bureau of Vital Statistics, 2013; US Census Bureau, 2014). The Chi-square analyses demonstrated additional differences between white and non-white race groups when bed sharing and crib use were considered. There were no disparities in sleep positioning.

The demographic characteristics expressed that infants deceased from sleep-related cause were 60% male. The average age at death ranged from a mean of 102.1 days for all infants in the initial cohort (n=384) to 80.1 for infants with complete responses for all maternal and infant factors. The most common month of death was January. Infants lived with at least one other child on average. Mothers of infants were most often high school-educated, an average of 25.8 years old, and more often employed.

To environmental factors, most incidents (78.9%) occurred outside of a crib and caregivers reported that half of infants usually slept some place other than a crib. The child was reportedly placed on his or her back 56.3% of the time, when data were known; however, the child was found in a position other than supine in 67.8% of incidents. An alarming 62.2% of babies were sharing a sleep surface at time of death.

Inferential statistics provided multiple insights. Correlational relationships were significant for younger mothers and also a higher number of children living with the infant and sleep-related cause of death. According to the correlation matrix, sleep-related deaths occur later in the infant's life than any other cause of infant mortality. These results were confirmed by logistic regression analysis, though the model only accounted for 32% of the variance in whether an infant died of a sleep-related cause.

Research question two

2) What are the types of safe infant sleep initiatives supported and administered by Iowa birthing hospitals?

Nearly 75% of hospitals surveyed had a policy on safe infant sleep or SIDS. Of those with policies, the main risk factors for SIDS and related cause were covered including position, environment, sleep place, bed sharing, co-sleeping, smoke exposure, and heat. Almost all (97%) had a back only sleep policy. Adoption of American Academy of Pediatric recommendations in 2011 by revising their safe sleep policy was reported by all but three hospitals.

The provision of safe infant sleep education to parents was not required in only four (11%) of respondents. Of those requiring education, clinicians covered all major risk factor topics, many (87%) provided handouts, and some (37%) had parents watch a DVD on prevention of SIDS. Clinicians confirmed the administration of education to parents in 63% of charts.

Nursing staff directors were queried for infant positioning habits. Most were not ever using stomach or side sleep unless a medical condition prevented back sleep. Fear of asphyxia was still a dominant fear of clinicians resulting in use of non-back sleep amongst 19% of hospitals, but very few yielded to parental influence as the reason to place babies on their stomach or side to sleep.

Research question three

3) What variances or deficiencies exist among birthing hospital education and clinical training programs that might be addressed to reduce the incidence of sleep-related infant mortality?

Subtle differences were apparent across hospitals, though no one hospital type dominated when differences were present. One quarter of hospitals did not have a SIDS or safe sleep education policy, though of those that did, the key elements of prevention were included in that policy. Topics of safe sleep education done with parents included all main components of prevention and co-sleeping and bed sharing were addressed in approximately 80% of hospitals.

About half of hospitals required safe infant sleep training of clinical staff and had a "Train the Trainer" program to conduct the training. OB coordinators rated the overall strength of their SIDS and related cause prevention programs at 7.66 on a scale of one to ten. Almost all hospitals were familiar with the Iowa SIDS Foundation, which provides educational materials to parents of newborns.

Summary

This chapter provided the results of the methods detailed in Chapter 3. Assumptions of normality were met for data used in inferential statistics. Descriptive statistics characterized infants, mothers, and the infant's environment for victims of SIDS and related causes. Lastly, the survey of hospital OB coordinators provided insights into current policy, education practice, and clinical training around safe sleep. Chapter 5 details the discussion of results, conclusions, recommendations, and implications for practice.

CHAPTER V

DISCUSSION, CONCLUSIONS, AND IMPLICATIONS

This chapter provides a discussion of the results of the study presented in chapter four, structured by theoretical framework and philosophical constructs and molded by current literature. The chapter begins with an overview of the entirety of the study, conclusions drawn from the results, and implications for practice in application of the results.

Summary of the study

Chapter one provided the background and framework for this study. The problem was stated and accompanied by research questions addressed in chapter four. Theoretical framework was identified and the study contexts woven within Bronfenbrenner's ecological model focused on the infant where the microsystem has the greatest influence. However, factors such as OB nurse interaction and education of parents in the mesosystem play a strong role in whether safe sleep practices are followed. Lastly, the potential for cultural affect explored in racial and ethnic differences within the sleep-related death population relate the exo-system.

Chapter one also established the framework for using the health belief model. The results of this study were merged into the model template for evaluation in future research in Chapter five.

Chapter two offered a review of major literature and while comprehensive in topic, was truly ephemeral in comparison to the breadth of research done on the topic of SIDS and related deaths. The literature review laid out the need for continued investigation and the potential for changing trends in parental and nursing practice. Core concepts were described to set the groundwork for the analyses of the study.

In chapter three, the philosophical assumptions, study design, and methodological approach were outlined. The study was entirely quantitative, though subjective, open-ended comments were solicited through the survey. Dependent and independent variables and methods for analysis were determined, as well as prospective limitations of the study.

In chapter four, the results of the study were presented. The results were parsed into the outcomes from the Child Death Reporting (CDR) system followed by those from the hospital survey. The CDR section follows a progression of increasingly complex analyses fully exploring potential interactions and predictive ability of variables of the infant, maternal factors, and the infant's sleep environment. The hospital survey section lays out the descriptive results grouped by topic.

The following sections deliver a summative discussion of the results, how the results fit into the theoretical framework, and suggestions for application of the insights provided by this study.

Discussion

In the eight years for which data were reviewed for this study, 384 infants died from sleep-related causes. While that is less than one percent of all births in the same time period, sleep-related fatalities are third in occurrence to birth defects and perinatal complications. Assigning SIDS as causality implies the reason for death is not known and without that knowledge makes it difficult to rationalize the death could have been prevented. However, it is possible to examine these deaths for patterns, commonalities, and practices that could have set the stage for a SIDS occurrence. The repeated demonstration of the triple-threat hypothesis of susceptible infant, critical developmental period, and exogenous stressor evidences the ability to identify risk and preventive factors that can impact the incidence of these deaths. The sleep-

related fatality subcategory of asphyxia is easier to research, though it is likely that many SIDS and undetermined or unknown instances are attributable to asphyxia.

It is because of the aforementioned rationale that sleep-related deaths were studied in aggregate including SIDS, undetermined or unknown, and asphyxia cases.

Within the context of Bronfenbrenner's bioecologic model, the microsystem holds the infant and his or her immediate caregivers. This study assesses characteristics of the infant and caregivers as primary influences on the outcome of sleep-related death. Hospital surveys enabled insight into practices demonstrated to caregivers at birth, directly affecting the infant. Hospital practice is influenced by policy and training, also ascertained within the study. Lastly, the issue of disparity was briefly addressed and while in the exo-system, presents opportunity for deeper investigation as to why any disparity is present.

Sleep-related mortality rate trends

It was unsettling to uncover increasing rates in infant mortality due to sleep-related cause. The trend assessed for this study utilized nine years of data classified by cause and manner of death. When examined by sub-classifications, SIDS and undetermined or unknown cause contributed to the rise in rates, while asphyxia were stable. However, it must be noted that medical examiner use of differing sub-classifications has changed over time. This trend defies that of national statistics. At the countrywide level, SIDS death rates have declined while asphyxia appears to be increasing. It is possible that classification preferences of medical examiners are affecting this trend, but that practice would not impact overall rates.

Assessment of the micro-system

Infant profile. Multiple infantile characteristics of importance identified in this study align with the literature. The average age at death was 102 days or slight more than three

months. The majority of SIDS deaths occur before an infant reaches six months of age (US Census Bureau, 2012). More males were observed to experience sleep-related death compared to females. The rationale for gender disparity is unknown and inexplicable, though pervasive in studies on sleep-related mortality. When compared to infants that died of non-sleep related causes, primarily birth defects, infants who suffered from sleep-related death tended to be older. This outcome is not unexpected as fatal birth defects most commonly occurred in day 0 of life in this cohort.

The results of inferential analyses aligned well. A relationship between sleep-related cause of death and an increasing number of children living in the home was identified in both correlation and regression. This dynamic was not noted in any literature reviewed for this study, but is a logical result. An increasing number of children makes it more difficult for a caregiver to watch the infant and could lead to confounders such as excess fatigue, stress, or fewer financial resources. An important potential risk associated with the number of children living with an infant is the possibility for bed sharing. The associative analysis for racial disparity revealed non-white infants were less likely to usually sleep in a crib and were more likely to bed share compared to white infants. However, non-white infants were not any more likely to be placed in a non-supine position to sleep. These findings collectively allude to the absence of a crib used exclusively for the infant. In conclusion, homes where other children live with the infant may increase the risk for sleep-related death and even more so in non-white homes.

Maternal factors. Maternal age is generally considered to be an important factor in assessing the incidence of a sleep-related death, as it is most prominent in younger mothers; however, any single maternal age has not been shown to increase risk (Cox, Zhang, Zotti, & Graham, 2011; Task Force on Sudden Infant Death Syndrome, 2011). From the frequency

analysis in this study of sleep-related incidents in Iowa, the average maternal age at time of infant death was 25.8 years. Correlation and regression statistics showed risk of sleep-related death decreased with increasing maternal age. At least one study has shown young maternal age as a risk factor for SIDS and the present study confirms those previous findings (Carlberg et al., 2012).

Several studies cited maternal educational attainment as a major predictor of SIDS mortality, this finding was not substantiated despite more than 50% of mothers reporting only a high school education (Colson et al., 2013; Kahn, Bauche, Groswasser, Dramaix, & Scaillet, 2001; Smylie, 2014). Maternal education level was unknown for nearly one-third of infant fatalities even when including non-sleep related deaths, which could have accounted for the absence of a significant finding.

Sleep environment. Characterization of the infant sleep environment was a critical component of this study as exogenous stressors, part of the triple-threat hypothesis, are usually derived from the environment. Data on an infant's sleep place, position, and surroundings are routinely captured in the CDR system. Complex inferential statistics were not possible for this segment of the study as data are not collected on infants dying of non-sleep related causes. However, frequency and Chi-square reviews were quite informative. Of infants included in the sleep-related mortality cohort, excluding those with unknown data, 78.9% were not found in a crib at time of discovery. Even more alarming was that 50% reportedly did not usually sleep in a crib. Bed sharing was highly prevalent with 40% of infants sharing a sleep surface with another child or adult at time of death, similar to one study with a comparable cohort where 47.1% were sharing a sleep surface. Nationally, evidence exists that bed sharing is occurring more often than

in past years with an estimated 13.5% doing so in 2010 and 6.5% in 1993 (Colson et al., 2013). The findings of this study confirm the importance of continued discouragement of bed sharing.

Disparities. Racial disparities were identified in this study and were limited to white and non-white race groups as races other than black were present in extremely low numbers. Multiple previous studies have shown higher rates of bed sharing among non-white race groups (Broussard et al., 2012). This analysis revealed a statistically significant difference in whether the infant's usual sleep place was a crib among white and non-white infant cases. Non-white infants were more likely to sleep someplace other than a crib. Additional statistical tests showed non-white infants were also more likely to bed share than white infants. Interestingly, there was no difference in sleep positioning prior to death or in position found at discovery between race groups. These results indicate the message of sleep position may be effectively reaching parents of all race groups, but that caregivers of non-white infants are less likely to secure a safe sleep environment for their children. Other studies have supported increased prevalence of bed sharing among non-white race groups, but no studies known to the researcher examined usual sleep place (Broussard et al., 2012; Hauck et al., 2003; Klonoff-Cohen & Edelstein, 1995). This finding supports potential action to provide consistent and separate sleep spaces for non-white infants.

Exo-system and discussion of hospital survey results

All analyses resulting from the hospital-based survey were frequency reviews. Some questions were likely influenced by subjective bias or reporting bias, as OB coordinators were asked to assume the rationale of others' actions. The main survey questions requested straightforward responses that could be substantiated by the provision of hospital policy.

Safe infant sleep policies. Respondents were asked whether their hospital had a policy addressing safe infant sleep and 21% stated no policy existed. A hospital policy is not required for safe sleep education to occur within a hospital setting, but may improve standardization in the information provided to parents, documentation of the provision of education, and a structure within which to update and track what efforts are routine. In support of this, one study reported higher agreement and awareness of American Academy of Pediatrics (AAP) recommendations when a SIDS prevention and education policy was in place (Shaefer et al., 2010). There was no single dominant hospital type (critical access, urban, etc.) without a policy. Surprisingly one urban hospital did not have a policy and was a facility with an average of more than 400 deliveries per year (ICAN of Northeast Iowa, 2012).

Of hospitals with a SIDS or safe infant sleep education policy, 90% addressed all risk factors in AAP guidance and reiterated such was practice when education was conducted with parents. Nearly all safe infant sleep or SIDS policies had been updated after 2011, the year of the last release of AAP recommendations where exclusive supine sleep was emphasized. This finding suggests hospitals are cognizant of changing guidelines and make efforts to align practice when change occurs.

Safe infant sleep practice. OB coordinators were asked how the delivery of education to parents is confirmed. It was reported more than half required documentation in the infant or mother's medical chart. Demonstration and education were nearly always occurring, according to the OB coordinators. The only consistent hesitation to always using supine sleep in the newborn nursery was fear of aspiration. Apparent in 19% of responses, the rate is lower than reported in past studies but is still surprisingly prevalent. Fear of aspiration was first identified as a concern and reason for non-supine infant positioning in the early-mid 1990's and even in

Iowa (Hein & Pettit, 2001). However, multiple studies have shown aspiration risk does not increase with supine placement (Bullock et al., 2004; Price et al., 2008; Stastny et al., 2004). This result indicates education of clinical staff is still needed to dispel concern about aspiration. Additionally, the use of non-supine sleep due to this concern may be even more common as results were reported as the OB coordinator's assumptions of the practice of clinical staff.

Training of clinical staff. Training on safe infant sleep or SIDS prevention was required at less than half of hospitals. However, such training is encouraged by hospitals through the use of "Train the Trainer" programs (41%), through the offering of continuing medical education (CME) provided by the hospital (24%), and online courses not resulting in CME credit (14%). Of those administering a program, one quarter use a standardized protocol. Implementing a training requirement for clinical staff assures parents receive more consistent SIDS prevention information, results in a better understanding of nationally-support recommendations, and serves as a regular reminder to clinical staff of the importance of educating parents of newborns (Bullock et al., 2004; Mason et al., 2013; Price et al., 2008).

Recognition of SIDS advocacy organizations. When queried about their awareness of state and local organizations, most OB coordinators knew of the Iowa SIDS Foundation, an organization providing educational materials to parents and clinical staff. Several coordinators mentioned the use of Foundation materials, including a DVD with testimonials from parents that suffered a SIDS fatality. This organization is clearly pervasive and effective in communicating an important message. The Iowa SIDS Foundation would be a logical partner in efforts to standardize or improve upon hospital-based education for parents of newborns, and even training of clinical staff.

National SIDS prevention organizations were less well known. First Candle was recognized by a little less than half of coordinators, and the online continuing education program on SIDS reduction provided by the Eunice Kennedy Shriver National Institute of Child Health and Human Development was familiar to only one quarter. One coordinator commented online she had never heard of the curriculum, but is now seeking to implement it next year.

Conclusions and Recommendations

The immediate environment surrounding an infant has a profound effect on the infant's ability to thrive and survive. Caregivers and parents are the central influence within that environment. This study outcome demonstrates the significance of a number of factors inherent to the infant and characteristics of the most common caregiver, the infant's mother. In agreement with past work, Iowa infants approaching two or more months of age and of male sex are at higher risk than their female counterparts or who are younger than six months. Discerning maternal factors include young maternal age and low educational attainment. The dominance of these two factors is problematic when attempting to implement interventions that are education-based.

Sadly, racial disparities were present in the data. On the positive side it appears that non-white caregivers may be receiving and acting upon advice to position infants on their back to sleep the same as white parents and caregivers. However, these infants are more likely to be sleeping someplace other than a crib or to be bed sharing. This result points to a potential need to provide cribs to families without one at the time of birth.

There is no question that the best opportunity to reach the majority of caregivers and parents of newborns is in the hospital immediately following birth. The inundation of information is likely overwhelming to parents and caregivers, but the safe sleep message must be

given and demonstrated using methods that promote retention. Hospitals mentioned education efforts that were strong and in the forefront, and most noted the example set by clinical staff was most likely supine sleep. Hospitals used DVDs, charted education, and were only allowed to use back sleep unless medical exception negated the position; however, the presence of a hospital policy was not universal. While a policy is not required to ensure the administration of a safe sleep or a SIDS program, it provides a source of truth and a means to track changes in recommendations that have occurred.

While not systemic, hospitals might benefit from state-level standardization of training options, educational materials, and policy guidelines. Resources may be needed to support a standardization effort, or perhaps new alliances forming as a result of accountable care organizations could find a means to support such an effort.

It is apparent that sleep-related mortality in Iowa is on the rise and needs to be addressed. Many of these deaths are considered preventable, regardless of the assignment of SIDS or undetermined/unknown cause. It is reassuring that deaths due to suffocation and asphyxia do not appear to be the source of the increase, unlike the national trend. However, misclassification of cause of death is always possible in these delicate cases. Attentiveness in tackling the entirety of the prevention of sleep-related infant deaths will have the biggest impact.

Use of the Health Belief model for program design

In terms of an actionable program design for hospitals, the Health Belief model provides an excellent template. The core assumptions for a safe infant sleep program are:

1) SIDS and related deaths are extremely detrimental events;
2) Preventive actions may be taken to reduce the likelihood of a SIDS death occurring; and,
3) Any and all caregivers should be taking on preventive actions.

Four main constructs must be addressed within the health program and two additional used in evaluation of the health program are defined in Table 22.

Table 5.1

Health Belief Model for a Safe Infant Sleep Prevention Program

Concept	**Definition**	**Application**
Perceived susceptibility	Assess caregiver's opinion of chances of experiencing a SIDS death	• Emphasize any family can experience a SIDS death • Women with less education and who are younger are more likely to experience a SIDS death • Children who are male and live with other children are at higher risk for SIDS
Perceived severity	Assess caregiver's opinion of the severity of experiencing a SIDS death	• The consequences are irreversible and need little explanation • Emphasis should be placed on the point that even one instance of bed sharing could result in a sleep-related death
Perceived benefits	Assess caregiver's belief in the effectiveness of the preventive measures recommended to reduce SIDS risk	• Define and demonstrate all AAP recommendations for SIDS prevention
Perceived barriers	Assess caregiver's ability to follow-through on preventive actions	• Determine if barriers exist to securing a safe sleep environment for the baby (i.e., crib, no bed sharing) especially with non-white families • Determine if intangible barriers (i.e., cultural beliefs, family practice, non-parent caregiver practice) exist
Cues to action	Assess strategies to activate action	• Reiterate messages with Iowa SIDS Foundation or other external materials for take-home • Address parental concerns with preventive actions • Ensure messages are reiterated with infant's primary care provider
Self-efficacy	Assess confidence in the caregiver's ability to take action	• Encourage safe sleep actions while in the hospital • Discuss the need to enforce safe sleep recommendations with all of the infant's caregivers

An effective safe sleep program will address all components in the aforementioned model, which requires comprehensive education with clinical staff in acquiring knowledge of risk factors and AAP guidelines, the ability to assess understanding of parents and caregivers, consistently demonstrating safe sleep practices, and having the ability to detect barriers to providing a safe sleep environment. Hospitals would benefit from sustaining their partnerships with the Iowa SIDS Foundations, as well as exploring crib provision programs or even national programs such as Cribs for Kids.

Implications for parents and caregivers

The most important message from this study for parents and caregivers is that safe sleep environments must always be in place, regardless of where the infant is sleeping. This study did not discern whether parents or caregivers were present at time of death, as the majority were parents. However, a SIDS or SIDS-related incident can happen in any setting and prevention has uniform effects in all settings. Practices such as having an infant always sleep in a crib (even portable cribs are acceptable) a crib free of bedding or other objects, alone, and preferably with a pacifier are universal.

Implications for clinicians

Clinicians are the most efficacious in enforcing and communicating safe sleep recommendations. This study shows that many hospitals have multi-faceted educational programs and largely enforce the practice of back-only sleep. Every hospital has differing capacity and funding for in-service training, support for online or outside continuing education, and custom training materials. Yet there are free resources, even free continuing education online training for clinicians, on SIDS prevention. The Iowa SIDS Foundation is a well-known supporter of hospitals and is able to provide take-home educational materials to families.

The key message for clinicians is that reiteration and demonstration by action are most effective. Clinicians encounter parents and caregivers at birth, but outside of the hospital may have numerous interactions within the child's first year. The safe sleep message should be given at every possible health care provider encounter. Clinicians must also be aware of the need to assess a parent or caregiver's level of understanding. Young, less educated mothers are more likely to experience a sleep-related infant death and prevention messages may need to be altered to ensure adequate understanding.

Implications for hospital administrators

Hospital administrators may benefit from reviewing the results of this study to determine whether a safe infant sleep policy is needed, should be revised, or if training may be needed for clinical staff. There are numerous examples of robust hospital policies on SIDS prevention available through hospital associations and professional organizations (Eunice Kennedy Shriver National Institute of Child Health and Human Development, 2013; First Candle, n.d.; Iowa SIDS Foundation, 2014; Young, Higgins, Raven, & Watson, 2013).

Implications for policy makers and advocates

An opportunity exists for policy makers to act on findings from research, like the current work, or on recommendations from the Iowa Child Death Review Team (ICDRT). Per Iowa Administrative Code, annual reports from ICDRT must be submitted to the legislature and the governor's office (Iowa Legislature, 2010). Rarely do these reports receive more than a fleeting moment of interest. Yet there are opportunities to enact encompassing laws, code, or rules to protect children and reduce the number of child deaths. Infant mortality for all causes has been declining slowly for several years; SIDS and related deaths are moving in the opposite direction. SIDS once was a cause of death that received great attention internationally as evidenced by the

extensive amount of literature on the subject. Yet national trends demonstrating an increase in deaths due to asphyxia and suffocation paired with research citing possible increases in bed sharing are of concern. Perhaps complacency has set in as it has been three decades since the "Back to Sleep" campaign began.

Policymakers are encouraged to assess Iowa trends and determine the need for standardized safe sleep education in birthing hospitals. Rules for child care and other caregivers providing supplemental care of an infant could be examined. The most consistent source for child mortality information, the ICDRT, receives no funding from the state despite the mandate to meet and submit an annual report. Lastly, giving attention to the issue of sleep-related infant death may revive the importance of this issue among parents and those that educate parents.

Recommendations for future research

In the early 1990's, SIDS researchers were convinced of the possibility for a uniform cause; genetic anomaly, unidentified issue with thermal regulation, asphyxia due to aspiration, etc. None of these causes could explain a significant proportion of fatalities. The triple-threat hypothesis provided a framework for the criteria necessary, but not always sufficient for SIDS to occur. The hypothesis iterated the critical period of development because the average time of SIDS occurrence is between 2-3 months. Triple threat also encompassed the various contributors to SIDS incidence such as those causes previously mentioned as exogenous stressors. The hypothesis implies fragility of any infant, and that in certain points in development, that fragility may be especially vulnerable to compromise. Future research should continue to include identification of possible exogenous stressors. For example, past studies have alluded to the role of infectious disease in cases classified as SIDS. Virulent, severe flu seasons and times of

heightened respiratory syncytial virus activity have resulted in spikes in infant mortality, though cases are not always differentiated by true cause. Additional investigation is needed in this area.

Clinical adherence to recommendations

From this work it is apparent fear of asphyxia is still prevalent among clinical staff. Recommendations from the American Academy of Pediatrics and research dispelling the risk of aspiration when back sleep is used may not be reaching clinic staff who administer safe sleep education. Hospital policies are likely the most effective way to document, standardize, and enforce safe sleep education guidelines and practice.

Periodic evaluation of policies and practice are imperative. Even minor changes in clinical practice may result in significant changes in the actions of parents and caregivers. It may also be of value for more hospitals to seek "Train the Trainer" programs as there are many reputable offerings nationally. Online trainings providing continuing education credit are available, but could be used more; especially by smaller hospitals with budget challenges.

The role of the natural parenting movement

There is a complex and assumptive dynamic with the movement of natural parenting, which encourages infant bonding, oftentimes through bed sharing and exclusive breastfeeding. The roots of this movement have some origination from the flawed research of Douglas Wakefield published in 1997 in the Lancet and later retracted (Godlee, 2011). A detrimental aspect of natural parenting may potentially be high prevalence of bed sharing. As national rates of infant deaths due to strangulation and asphyxia continue to rise, research in in this area is needed. We need to determine whether the natural parenting movement is contributing to the increase in infant mortality, and whether alternatives to bed sharing could be accepted. The AAP included in its most recent 2011 guidelines that parents should co-sleep, share a room with their

infant sleeping next to the bed in a crib (Moon, 2011). Co-sleeping promotes infant bonding, frequent breastfeeding, and allows a comforting proximity between parents and infants without endangering the infant. If natural parenting were identified as a contributor to increased mortality, acceptance in substituting co-sleeping should be evaluated as well.

Persistent racial disparity

An interesting phenomenon was apparent in this study; consistent practice of supine sleep among all race groups, but lack of crib use and higher likelihood of bed sharing among non-whites. Iowa lacks an intensely diverse population, and even with that limitation the evidence supporting practice, but not the resources to maintain a safe sleep environment were apparent. Studies addressing this phenomenon were not identified. Therefore, it is recommended that future research include a focus on parents and caregiver ability or willingness to secure a safe sleep space for their infant.

Evaluation of safe infant sleep programs using the Health Belief Model

The current study pulled findings into a health belief model with the intend of setting the stage for future research. The present findings provided an Iowa-specific profile of infants affected by sleep-related mortality and accompanying risk factors. In addition, strengths and weaknesses of hospital policy, practice, and training were identified. By using these factors in the health belief model format a seemingly efficacious program could be built. The model provides a proven structure for successful evaluation of the components of a health education program. Future research should include the evaluation of safe sleep programs using the health belief model.

Improved surveillance

Lastly, consistent observation of real-time infant mortality incidence is needed. This recommendation is focused toward epidemiologic surveillance and helps detect abnormal surges and declines in trends. If real-time increases in mortality are identified and communicated to the clinical community, interventions can be implemented preventing immediate and future deaths. Infant death investigations are not incredibly timely, but even with a week or two delay, the advent of electronic reporting systems supplies access to data that is actionable. Reporting systems should be monitored to detect fluctuations in mortality patterns among infants.

Final thoughts

The importance of sleep-related infant mortality was first apparent to me when I investigated a cluster of infant deaths initially attributed to SIDS in 2008. The increase in deaths was more than four times the expected rate and was only detected because of two astute pathologists who had received the majority of cases. Following that investigation, it was apparent improved surveillance, collaboration, and efforts to educate the public were needed to eliminate preventable infant deaths. Child death review teams do remarkable work with limited resources in identifying and communicating population-based problems contributing to child mortality; however, much work remains. An average of 43 infants per year; 384 in nine years, is too many infants to lose to largely preventable causes. We need to revisit how we view SIDS and related deaths in infants and emphasize the criticality of safe sleep environments. We need to assess a parent's ability to secure a separate sleep space for his or her infant at the time of birth. Lastly, we need to continue to monitor these events to ensure abnormalities do not go unnoticed. The most vulnerable stage of life is infancy. It is the responsibility of adults to protect children through the early stage of life and beyond.

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APPENDIX A

Iowa Hospital Safe Infant Sleep Education Survey

Select your hospital from the list below (all hospital names will be kept confidential).

Please provide your position/job title.

Select the professional category that aligns with your current position.

- Healthcare clinician (e.g., physician, nurse)
- Education (e.g., teacher, school administrator)
- Social services (e.g., social work)
- Public health
- Other
- Other

How long have you worked in your current position?

Select the number of years you have worked in current profession.

Please list your professional credentials (e.g., MD, MPH, LCSW).

Does your hospital have a birthing or obstetrics unit?

- Yes
- No

- ◯ Other

Do nursing staff at your hospital routinely administer safe infant sleep or SIDS education to parents of newborns?

- ◯ Yes
- ◯ No
- ◯ Not sure

Does your hospital have a policy addressing safe sleep or SIDS education to parents of newborns?

- ◯ Yes
- ◯ No
- ◯ Not sure

What components of safe sleep education are required according to hospital policy (select all that apply)?

- ☐ SIDS
- ☐ Sleep location (e.g., crib, no adult bed)
- ☐ Bed sharing (i.e., infant sleeping in the same room and same bed as the parent)
- ☐ Co-sleeping (i.e., infant sleeping in the same room as the parent, but in a separate sleep bed)
- ☐ Sleep environment (e.g., crib with no bumper pads, stuffed animals)
- ☐ Sleep position (e.g., back only)
- ☐ Smoke exposure
- ☐ Overheating/room temperature
- ☐ Safe sleep education is not required by hospital policy
- ☐ Other

Does your hospital's safe sleep or SIDS prevention policy require clinical staff place infants on their back to sleep?

- ◯ Yes, only back sleep is allowed
- ◯ Yes, but side sleep is occasionally allowed
- ◯ No

In what year was your hospital policy last updated?

Was your hospital safe sleep or SIDS prevention policy updated following the American Academy of Pediatrics revised recommendations in 2011 for back only sleep?

- ◯ Yes
- ◯ No
- ◯ Not sure

What topics are covered in safe infant sleep education delivered to parents of newborns (check all that apply)?

- ☐ SIDS
- ☐ Sleep location (e.g., crib, no adult bed)
- ☐ Bed sharing (i.e., infant sleeping in the same room and same bed as the parent)
- ☐ Co-sleeping (i.e., infant sleeping in the same room as the parent, but in a separate sleep bed)
- ☐ Sleep environment (e.g., crib with no bumper pads, stuffed animals)
- ☐ Sleep position (e.g., back only)
- ☐ Overheating
- ☐ Smoke exposure
- ☐ Other

In what ways do you ensure that safe sleep education is delivered by clinical staff to all parents of newborns at your hospital (check all that apply)?

- ☐ Nursing staff are required to provide safe sleep or SIDS education to all parents per hospital policy
- ☐ Nursing staff are required to chart safe sleep or SIDS education administration in the mother and/or infant's medical record
- ☐ Nursing staff are encouraged, but not required to administer safe sleep or SIDS education to parents
- ☐ Safe sleep or SIDS information is not routinely provided to parents
- ☐ Provide a handout/brochure in the discharge packet of education material provided to families
- ☐ Encourage families to watch safe sleep education included on our hospitals closed circuit TV channel prior to discharge
- ☐ Have the nursing staff model the appropriate behavior during the infants hospital stay, by always placing infants on their back and having nothing in the crib.
- ☐ Other

For which of the following reasons do you believe would clinical staff place infants on their SIDE or other non-back position (check all that apply)?

- [ ] To prevent aspiration
- [ ] Infant sleeps better
- [ ] Parent preference or concern
- [ ] Prematurity
- [ ] Infant medical condition restricting or preventing use of back sleep
- [ ] Side position is not used by clinical staff
- [ ] Stomach position is not used by clinical staff
- [ ] Other

Are your clinical staff required to complete safe sleep or SIDS training?

- ◯ Yes
- ◯ No
- ◯ Not sure

In what ways does your hospital encourage clinical staff to complete safe sleep or SIDS education (select all that apply)?

- [ ] Continuing medical education (CME) done outside the hospital
- [ ] Continuing medical education (CME) provided by the hospital
- [ ] Online course, CME earned
- [ ] Online course, non CME
- [ ] Train the trainer programs
- [ ] Other

Does your hospital administer a standardized safe sleep or SIDS education program to clinical staff?

- ◯ Yes (list the name of the program below)
- ◯ No
- ◯ Not sure

How long has your hospital had a safe sleep or SIDS education program?

- ◯ <1 year
- ◯ 1-4 years
- ◯ 5-10 years
- ◯ >10 years

- ◯ Not sure

Do you distribute any safe sleep or SIDS educational materials to parents?

- ◯ Yes (describe)
- ◯ No
- ◯ Not sure

Rate the strength of your safe sleep or SIDS program on the following scale:

	0	1	2	3	4	5	6	7	8	9	10
0=Weak, 10=Strong											

What local, state or national safe sleep or SIDS programs are you familiar with (check all that apply)?

- ☐ Iowa SIDS Foundation
- ☐ First Candle
- ☐ Continuing Education Program on Sudden Infant Death Syndrome (SIDS) Risk Reduction: Curriculum for Nurses (Eunice Kennedy Shriver National Institute of Child Health and Human Development)
- ☐ Cribs for Kids
- ☐ Other (list)

Would you be willing to provide a copy of any policies or procedures that specifically address safe sleep or SIDS education for parents?

- ◯ Yes
- ◯ No
- ◯ Not sure

Please email your safe infant sleep or SIDS prevention policy to Meghan Harris at meghan.harris@drake.edu. Your policy will not be shared with anyone and will only be used to identify best practices.

What efforts, if any, might help improve your safe sleep or SIDS education program (check all that

apply)?

- [ ] Standardized education protocol provided by the state or medical society
- [ ] Train the trainer program
- [ ] Data or statistics on the number of infants affected by unsafe sleep or SIDS
- [ ] Funding to support staff CME or attendance at safe sleep educational opportunities
- [ ] Not sure

Comments

Contact Information (optional)

Name

Email

Phone

Thank you for your participation!

APPENDIX B

Number of Deliveries by Hospital, Iowa

Allamakee	Veteran's Memorial Hospital	112
Appanoose	Mercy Medical Center – Centerville	81
Black Hawk	Allen Health System	983
Black Hawk	Covenant Medical Center	1,438
Boone	Boone County Hospital	157
Bremer	Waverly Health Center	231
Buena Vista	Buena Vista Regional Medical Center	302
Calhoun	Stewart Memorial Community Hospital	62
Carroll	Manning Regional Healthcare Center	34
Carroll	St. Anthony Regional Hospital	379
Cass	Cass County Memorial Hospital	128
Cerro Gordo	Mercy Medical Center – North Iowa	954
Cherokee	Cherokee Regional Medical Center	114
Clay	Spencer Hospital	281
Clayton	Guttenberg Municipal Hospital	38

Clinton	Mercy Medical Center – Clinton	545
Crawford	Crawford County Memorial Hospital	122
Dallas	Methodist West Hospital	378
Davis	Davis County Hospital	35
Delaware	Regional Medical Center	158
Des Moines	Great River Medical Center	544
Dickinson	Lakes Regional Healthcare	141
Dubuque	Mercy Medical Center – Dubuque	854
Dubuque	The Finley Hospital	719
Fayette	Palmer Lutheran Health Center	94
Floyd	Floyd County Medical Center	97
Greene	Greene County Medical Center	48
Hamilton	Hamilton County Public Hospital	108
Hardin	Ellsworth Municipal Hospital	90
Henry	Henry County Health Center	141
Howard	Regional Health Services of Howard County	77
Ida	Horn Memorial Hospital	56
Jackson	Jackson County Regional Health Ctr	14

Jasper	Skiff Medical Center	182
Johnson	Mercy Iowa City	1,146
Johnson	University of Iowa Hospitals and Clinics	1,977
Kossuth	Kossuth Regional Health Center	116
Lee	Fort Madison Community Hospital	271
Lee	Keokuk Area Hospital	219
Linn	Mercy Medical Center – Cedar Rapids	784
Linn	St. Luke's Hospital	2,605
Lucas	Lucas County Health Center	68
Lyon	Sanford Hospital Rock Rapids	11
Mahaska	Mahaska Hospital	193
Marion	Knoxville Hospital & Clinics	63
Marion	Pella Regional Health Center	331
Marshall	Marshalltown Medical and Surgical Center	566
Monona	Burgess Health Center	39
Montgomery	Montgomery County Memorial Hospital	79
Muscatine	Trinity Muscatine	329
O'Brien	Sanford Sheldon Medical Center	146

Osceola	Osceola Community Hospital, Inc	28
Page	Shenandoah Medical Center	101
Palo Alto	Palo Alto County Health System	104
Plymouth	Floyd Valley Hospital	94
Polk	Broadlawns Medical Center	260
Polk	Iowa Lutheran Hospital	470
Polk	Iowa Methodist Medical Center	3,102
Polk	Mercy Medical Center – Des Moines	4,916
Polk	Mercy Medical Center – West Lakes	177
Pottawattamie	Alegent Hlth Mercy Hsp-C Blffs	653
Pottawattamie	Jennie Edmundson Hospital	435
Poweshiek	Grinnell Regional Medical Center	165
Scott	Genesis Medical Center – East	2,330
Scott	Trinity at Terrace Park	416
Shelby	Myrtue Medical Center	74
Sioux	Hegg Memorial Health Center	75
Sioux	Orange City Health System	216

Sioux	Sioux Center Community Hospital/Health Center	226
Story	Mary Greeley Medical Center	1,110
Union	Greater Regional Medical Center	202
Van Buren	Van Buren County Hospital	35
Wapello	Ottumwa Regional Health Center	655
Washington	Washington County Hospital and Clinics	127
Wayne	Wayne County Hospital	116
Webster	Trinity Regional Medical Center	543
Winneshiek	Winneshiek Medical Center	204
Woodbury	Mercy Medical Center – Sioux City	414
Woodbury	St. Luke's Health System, Inc	2,043
Wright	Wright Medical Center	198